THE IRON TRADE REVIEW

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THE IRON TRADE REVIEW.

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CLEVELAND, O., FEBRUARY 26, 1891.

THE WEEK IN IRON CIRCLES.

General Features. The question is no longer, "Will there be an extended revival in the iron business?" but, "How much longer will the revival be delayed?" Much will depend upon readjustments in freight schedules now being made by Northern railroads, but it does not require a great deal of foresight to see that the reduction in rates to iron men must of necessity be heavy, if not radical. The placing of a safe and conservative man at the head of the Treasury Department has had the effect of maintaining confidence in the world, and this cannot but have a reflex influence for good upon general trade. Our reports from trade points present many encouraging features, as will be seen below: At Detroit, a decidedly large number of inquiries, both for smaller and larger lots, is noted, and this refers to both Lake Superior charcoal iron and Southern coke, the latter being confined chiefly to the lower grades, however. This inquiry for Lake Superior comes principally from the malleable manufacturers, who report a large volume of business existing at the present time. It looks as if the early buying, which they did last year, was to be repeated during the present season. Prices have in no way changed, but cannot be lower than they are at present. The obstacles in the way of large manufacture of coke iron which we mentioned in our report of a week ago, still continue, and have made a very strong coke iron market, which will continue to gain strength unless some of these causes be removed very soon, as at present there is a large inquiry remaining unsatisfied. Altogether the market looks decidedly better than a week ago. The week at Chicago has been characterized by a decided stiffening in prices on coke irons, particularly those brands made in the Alabama district, furnaces in that region having advanced prices from 25 to 50 cents per ton. The advance has been brought about by the large demand which has prevailed of late and the heavy sales made by most of the leading companies. Charcoal irons have, however, remained very quiet, few transactions of importance having been consummated. The stiffening of prices has had the effect of somewhat checking buying movement of the Chicago district, consumers feeling indisposed to make large purchases at the advanced figures at which coke metal is being held. The outlook, however, points to a maintenance of prices now ruling; the tendency being upward and further advance on coke irons is not unlikely to occur. The present status of Southern furnaces is the subject of considerable inquiry. So far as they are concerned it can be said that nearly all of them have fallen into line and are refusing to book orders excepting at an advance of about 50 cents per ton over prices recently ruling. Inquiries have been numerous at Cincinnati during the past week for forge irons, and no doubt now exists regarding the scarcity of these grades. The low prices for muck-bar do not afford the rolling mills any margin for profit and there is some hesitation about placing orders for pig iron at an advance, until the finished product shows more signs of improvement. The Southern furnaces are resuming operations less rapidly than was expected, both on account of the lack of fuel and the difficulty of obtaining a sufficient ore supply, the extremely wet weather having seriously interfered with ore mining. Our Louisville correspondent notes one large transaction during the week, an additional purchase of 6,000 tons. The balance of the buying has been of smaller lots, though purchases of 1,000 and 1,500 tons for delivery running through the year were made. The price at which most of the iron was sold was on basis of $10.25 for grey forge at Birmingham; one sale, however, of 6,000 tons of grey forge is reported at $10.50 cash, cars at furnace Buyers appear willing to purchase for their future wants at present prices, feeling that iron is very low and that it is to their interest to buy. Business at St. Louis during the past week has been fairly active. Inquiries continue to come in and a number of small sales have been made. The Southern furnaces have not caught up on orders delayed during the strike, and on some grades there is quite a scarcity. The call for coke is quite large on account of the coke miners' strike.

The Local Situation. Since our last report there has occurred a noticeable improvement in the pig iron market, an improvement, however, chiefly in the tone of the market, although there has been a substantial advance in price as well. The latest sales of Bessemer that can be reliably traced were made on a basis of $16.85 in Pittsburgh, which makes the valley price an even $16, cash. The sales at this figure were small, to be sure, but the transaction bids fair to be followed by others in the same line. There has also been an advance in Southern irons, the price of No. 2 foundry, which, until recently, was delivered in the valley at $13.75, having jumped to $14.65. From other quarters a report comes that Bessemer iron is being held at two valley furnaces for an offer of $17, which would call for the advance of the quotation by another dollar. Just how far-reaching this feeling of strength is, must be a matter of conjecture; at any rate, the more conservative iron men will not move in the matter until the volume of sales shall give indication of the permanency of the improvement in the situation. The coke strike seems as far from a settlement as ever. One reason, perhaps, for the independent position assumed by the syndicate people, is found in the fact that all the furnaces and mills connected with the coke producers are plentifully supplied with material, and have been storing up coke for a long time, for just such an emergency as the present. Under the circumstances, these firms are enabled to keep right on with their work, taking advantage of the advance in the price of pig iron and its products, as occasioned by the gradual wiping out of stocks in the two valleys. There is no question that the price of all pig material still in the valley is being enhanced as the stocks grow less, and as there is considerable consumption still supplied from that source, the total exhaustion of these stocks is but a question of a very few weeks. It is this very question that is again disturbing the pig iron interests, for the present advance is hardly safe enough to warrant the resumption of general activity on the basis of old prices of coke and rail freights, while the coke drawers, very naturally, will decline to work at a reduction of wages, in the face of a substantial advance in the price of pig iron. There is also some danger that one or two valley firms, who either have a supply of coke on hand or who coke their own coal, and whose furnaces are now banked, may find the advance sufficiently profitable to start up again, in which event a general starting up could only be prevented by the continuation of the coke strike. The vessel men have thoroughly canvassed the situation, and having satisfied themselves of the certainty of a meager ore season, are taking steps to place as much tonnage as they can find room for in other channels, many of them going into the lumber trade. The increase in the west-bound coal trade has been so remarkable during the past few years that there has been a constant demand for coal tonnage of late, and it is thought that quite a good deal of the disengaged tonnage will carry coal this season. Time was, when vessels would go up the lakes light, to come down with ore; and the present outlook for the ore business is so very poor, that the condition may be reversed—vessels going up with coal, to come down light.

LABOR COST IN IRON AND STEEL.

Most interesting figures are given by Labor Commissioner Wright regarding the cost of iron and steel production. We select three sample tables as of especial interest to our readers:

COST OF PRODUCING A TON OF PIG IRON.

Locality.	Cost of materials.	Labor.	Total cost.
Northern	$17.728	$3.589	$23.165
Northern	13.223	1 194	15.202
Southern	7.757	1.461	10 279
Northern	11.991	.975	13.584
Northern	11.663	1.364	13.433
Europe	9 559	.418	10 394
Europe	12.228	.912	13 434
Great Britain	9.230	.601	10 290
Great Britain	9 308	.743	10 729
Europe	14.219	.719	15.075
Europe	6.785	.470	7.736
Northern	12 267	2.135	15 256
Great Britain	6 454	618	7.677
Northern	11.147	1.166	12.820
Southern	7.173	1.8 6	9.634
Southern	7.202	2.608	10.267
Southern	8.877	1 218	10.822
Southern	8 164	.595	9.623
Europe	9.885	1 414	12 070
Great Britain	9.529	.769	10.893
Europe	9.061	.711	11.107
Europe	7.327	.755	8.765

COST OF PRODUCING A TON OF STEEL RAILS

Locality.	Net cost of materials.	Labor.	Total. cost.
1. United States	$21.109	$1.540	$24.799
2. United States	25.114	1.382	27.687
3. Continent of Europe	17.672	1.013	19.576
4. Continent of Europe	18.066	2 519	22.184
5. Continent of Europe	18.066	4 041	25.652
6. Continent of Europe	18.231	2 583	23.141
7. Continent of Europe	18.103	2.689	23.190
8. Continent of Europe	18.664	2.974	23.743
9. Continent of Europe	18.808	1.028	22.439
10. Continent of Europe	19.880	2.160	26.711
11. Great Britain	18.058	2.548	21.907
12. Great Britain	16 395	1.363	18.588
13. Great Britain	17.159	1.583	20 178

AVERAGE EARNINGS OF WORKMEN.

Locality.	Av. daily earnings.	Total earnings.	Average earnings.	Individual earnings.*
Northern district of the U. S.	$2.03	$52,236	$ 69	$735
Northern district of the U. S.	1.67½	75,519	149	592
Northern district of the U. S.	1.58½	47,371	192	574
Northern district of the U. S	1.70	49,296	154	589
Northern district of the U. S.	1 53½	58,272	304	533
Northern district of the U. S	1.47	31,593	277	520
Northern district of the U. S.	1 62	40,029	288	569
Southern district of the U. S.	1.34	44,327	76	490
Southern district of the U. S.	1.23	44,936	98	426
Southern district of the U. S.	1.22	15,173	131	422
Continent of Europe (3 mos.)	0.70	1,895	53	63
Continent of Europe (3 mos.)	0.64	5,478	50	58
Great Britain (3 months)	0.67	7,761	52	59
Great Britain (3 months)	0.62	12 795	49	55

* If position was continuously filled by same person.

Three things are quite evident from the foregoing: 1. The South has a decided advantage in the production of pig iron. 2. Great Britain and the Continent possess a clear advantage in the matter of steel rails. 3. Nowhere in the world is labor better paid than in the Northern group of the United States.

THE YEAR'S SUMMARY OF A GREAT STEEL PLANT.

Here are a few figures from the annual report of the great Illinois Steel Company's works for the manufacturing year of 1890:

The average number of men employed was 9,658; in 1889 it was 8,360.

The total pay roll was $6,863,416, as against $3,660,888 in eight months of 1889.

The company received in 1889 88,554 cars of material, and shipped 40,954 cars. Last year it received 150,745 cars, and shipped 58,676 cars.

It received last year 4,642,666 tons of raw material. Of this 755,183 tons were received by lake and 2,887,477 tons by rail.

The company shipped 928,769 tons of finished product. It purchased supplies and stores outside of the raw material for making iron costing $1,751,587.

The following is the output of the works in finished material: 720,424 tons of pig iron, 35,799 tons of spiegel iron, 733,218 tons of ingot, 508,719 tons of rails, 80,155 tons of billets, 54,539 tons of rods, 69,775 tons of iron and steel beams, etc.

Four million seven hundred and eighty-two thousand eight hundred and thirty-seven dollars were expended last year for real estate and in construction.

The total bills and accounts receivable are $4,078,000, or nearly double those of a year ago.

The total net receipts for 1890 were $2,578,089, net profit, $2,059,105, or 11.59 per cent. on the capital stock.

PITTSBURGH AS A LAKE PORT.

Thanks to Mr. J. M. Goodwin, Engineer of the Pennsylvania Ship Canal Commission, we are in receipt of a copy of the exhaustive and instructive report just submitted to the Pennsylvania Legislature. We have heretofore given the outlines of the recommendations made by the Commission, and need not, therefore, repeat them at length. Let it suffice to say that the proposed canal, if built, will run from Conneaut, Ohio, to Beaver, Pa., thence by river to Pittsburgh, a distance in all of 123½ miles, necessitating the construction of 53 locks, and being of a uniform depth of 14 feet. Concerning the route in which Cleveland would be more directly interested, the report says:

The line of least distance between the lake and river lies between Cleveland and a point on the Ohio about 18 miles below Rochester. This line is about 85 miles in length. The distance from Cleveland to the mouth of the Beaver by this line, and the Ohio River, is about 103 miles. The distance by rail from Cleveland to the mouth of the Beaver, via Youngstown and the Mahoning and Beaver Valleys, is 107 miles. By way of the Cleveland and Pittsburgh Railroad, the distance from Cleveland to Rochester is 124 miles. Possibly a practicable route for a large canal from Cleveland to Rochester might be found having length of no more than 120 miles. The summit-level on such route might perhaps be made at elevation of 1,103 (or 530 feet above Lake Erie), but the probability is that it would necessarily have an elevation of about 1,120. This would put it 104 feet above the summit-level on the Conneaut route herein recommended.

For similar reasons the route by Warren, Ohio, is abandoned, and the route from Conneaut is recommended. The Commission estimates the cost of the canal at $26,375,188. Elsewhere we reproduce what, perhaps, is the most interesting part of the report—an abridgement of a report by Mr. Goodwin on the comparative cost of transportation by lake and canal. We regret that, owing to limited. space, we are compelled to omit much reliable data given by Mr Goodwin, but his article, together with the cuts accompanying the same, will give a very fair idea of the project from the standpoint of its friends. It is certainly a stupendous, though by no means impracticable, enterprise; and if it ever materializes it will work a mighty change in the present methods of shipping iron ore from mine to furnace.

OUR recent guests from abroad have shown their appreciation the hospitalities extended by the engineering societies of the United States by presenting several members of Committee of Arrangements with unique testimonials. To the three leading members of the committee the German ironmasters have presented handsome silver goblets, fashioned in the form of Bessemer converters, and to various gentlemen the English visitors are about to forward silver candelabra and other silver ornaments.

CONCERNING the future of shipbuilding in the United States, the *Shipping World* (London) is forced to this conviction: "It is characteristic of America that though she is the youngest competitor in iron shipbuilding, she has made the most rapid strides. Already the United States ranks next to Germany in amount of tonnage on the stocks. She may soon be the rival of which Great Britain will have to take the most account." This is praise from Sir Rupert, indeed.

IF tangible results do not grow out of the recent Pan-American Conference, it will not be the fault of our State Department. The latest production of the Department is a neat "Hand Book of the American Republics," certainly a monument of careful compilation and a credit to the able Director, Mr. W. E. Curtis.

OHIO still maintains third place in the ranks of steel-producing States, having turned out 405,365 net tons in 1890, as compared with 331,298 tons in 1889, This increase of 64,067 tons over the preceding year is not bad, considering the rapid advance of competing States.

PENNSYLVANIA and Illinois produced in 1890, 1,983,997 net tons of steel rails (Pennsylvania 1,396,460, Illinois 587,537), while all other States produced only 29,191 tons. Ohio has apparently dropped out of consideration within the past two years.

CANADA is in the throes of one of the hottest campaigns ever known in that country—and that is saying a great deal. Protectionists on this side of the border will await the outcome with interest.

IN 1890 about one-half of the Bessemer steel ingots produced in the United States were converted into rails.

IN 1890 the United States made 4,128,535 net tons of Bessemer steel ingots, an increase of 25 per cent. over the production in 1889.

ILLINOIS, as a steel producer, is making substantial progress. From 740,00 net tons in 1889 she advanced to 848,751 tons in 1890.

PENNSYLVANIA produced 2,515,424 net tons of steel ingots in 1890—more than half the total product of the country.

OF Bessemer steel rails the United States produced 2,013,188 net tons, an increase of 22 per cent. over 1889.

THE PROPOSED LAKE ERIE AND OHIO RIVER SHIP CANAL.

By J. M. GOODWIN.*

(Engineer of the Pennsylvania Ship Canal Commission.)

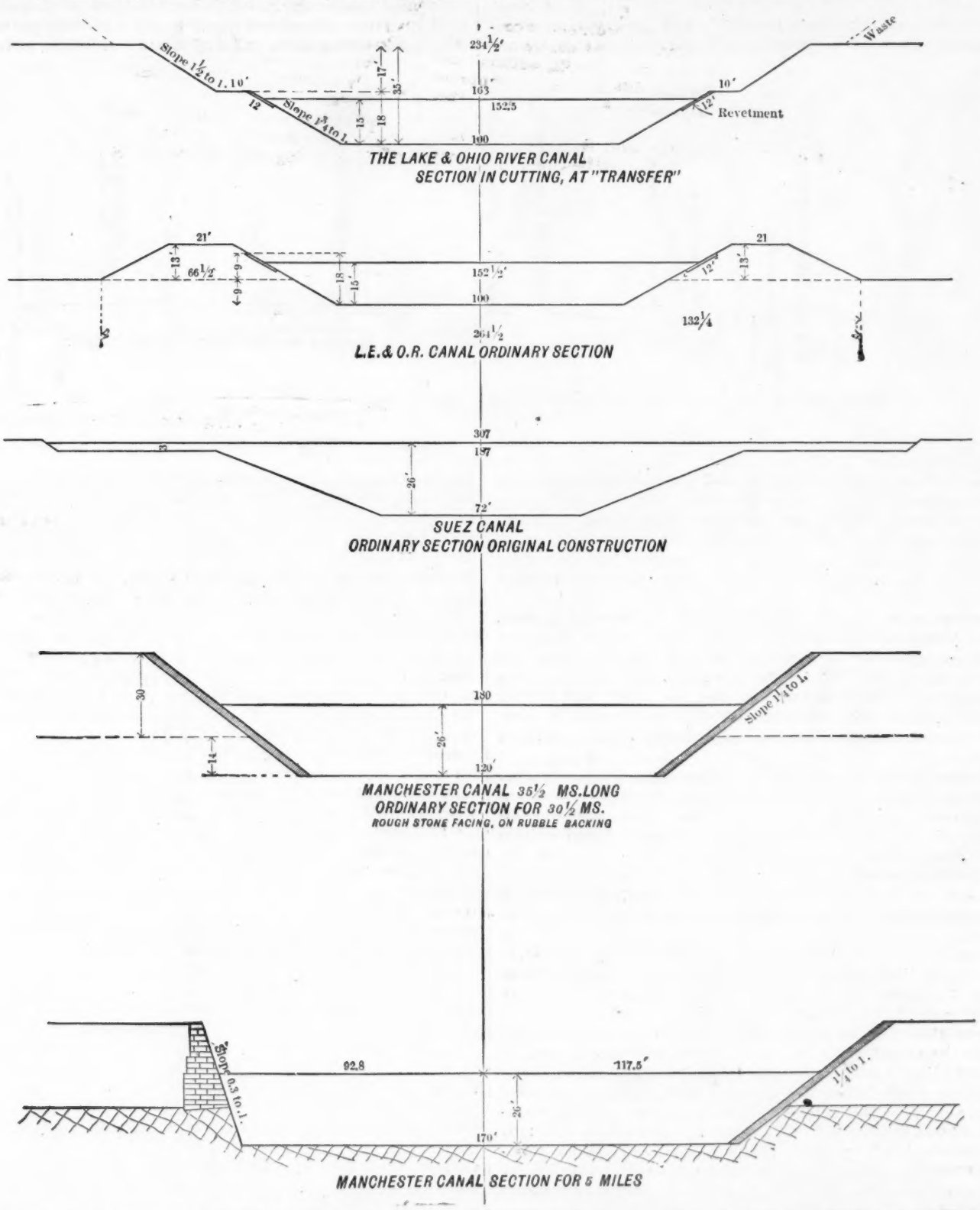
Of several self-evident truths recognized throughout the commercial world, none more directly recommends itself to the understanding than this: that without adequate means for transportation of commodities commerce is an impossibility.

This is the axiom. From it we logically infer that, given a demand, or want, in one place, and existence in another place of a commodity suited to satisfy that want, means for transportation of the commodity having been provided commerce in the commodity will ensue. And in commercial history, and statistics social and commercial, we find ample basis for the proposition that, in all cases where such demand arises from vital necessity, or is a natural growth from natural wants, or if it is merely a demand growing not from positive needs but from acquired tastes, or from any one of the practically imperative needs created by modern civilization, provided the satisfaction of the demand results in an enhancement of the physical condition of the "comfort," and of the general well-being of the people immediately affected; or in an improvement and enlargement of means for "rapid transit," or for economy of time in any direction; commerce in the commodity or commodities necessary to satisfaction of the demand will increase with the increase of the people, the community or the nation, in which the demand originated, and, through gratification of it, has grown.

As iron (the term being taken to cover the derivatives of iron) is, in current practice, the prime essential to any operation for furtherance of commerce, betterment of means for travel, or improvement of structures, whether originating with the engineer, the mechanician or the architect. and as with us population and wealth increase year by year, while as yet the conditions which will distinctly check such expansion are hardly beyond incipiency, we have good warrant for calculating upon a considerable annual increase to continue through many years to come, of our already very large interstate commerce in the ores and other materials used in making pig iron, as well as in the iron produced.

In his recent extremely interesting and valuable address at the New York meeting of the American Institute of Mining Engineers, Hon. Abram S. Hewitt, basing his calculation upon thoroughly authenticated data, clearly set forth in the address, estimated that by the year 1900 the United States will have reached a production of 15,750,000 gross tons of pig iron; that is to say, 17,640,000 net tons. Mr. Hewitt put the production of pig iron in the United States in the census year 1890 at 9,579 779 net tons. The estimated product of 1900 exceeds this by 8,060,221 tons. The average annual increase would be 806,022 tons. Actual production in 1888 was 7,268,507 net tons; in 1889, 8,517,-068 net tons, increase in this one year 1,248,561 net tons.

In view of facts cited in his address, Mr. Hewitt, with direct reference to tariff legislation, said: "One of the perplexing elements in the consideration


Slope 1½ to 1.
Slope 1¾ to 1.
Waste
Revetment
THE LAKE & OHIO RIVER CANAL
SECTION IN CUTTING, AT "TRANSFER"
L.E.& O.R. CANAL ORDINARY SECTION
SUEZ CANAL
ORDINARY SECTION ORIGINAL CONSTRUCTION
MANCHESTER CANAL 35½ MS. LONG
ORDINARY SECTION FOR 30½ MS.
ROUGH STONE FACING, ON RUBBLE BACKING
Slope 0.3 to 1.
Slope 1¼ to 1.
MANCHESTER CANAL SECTION FOR 5 MILES

*Extracts from Report to Pennsylvania Legislature.

of the future of the iron business is removed from the problem when the conclusion is reached that henceforth the ability of Europe to supply its own demand for crude iron will be fully tasked, and the United States must look to its own resources for supply of the great demands of the coming century."

He continues as much to the point which we wish to present as if he had been speaking to the question which we are now considering: "So far as we "are concerned then, the question is substantially whether this country can "nearly double its production (of pig iron) in the next ten years without so "seriously increasing the present cost of iron as to restrict consumption and "and arrest the rate of progress at which the world is now moving forward."

We may safely assume that, in view of the practically unlimited stores of fuel and iron ores existing in their country, the people of the United States will not, by any neglect of means at their command, fall back from the position among iron-producing nations which they have attained; and as enlargement of means, for and diminution of cost of, transportation of raw material are, to any unprejudiced observer of the conditions affecting the matter in question, obviously necessary to a maintenance of our rate of progress in iron-production, we conclude that the country will, without any unnecessary delay, adopt such means, to the end desired, as shall approve themselves to its deliberate judgment as indisputably better than any other possible.

Were water carriage not, positively less costly and, generally, more convenient, than land-carriage for transportation of commodities, which, for any reason, are preferably handled in bulk, we should, nevertheless, in order to maintain the current rate of increase in production in the iron-making districts most favorably situate with relation to the ore fields of the Northwest and to the great coke-producing region of Pennsylvania, respectively, necessarily supplement the existing railway capacity for transportation of ores from Lake Erie to those districts, by establishment of a proper waterway between the Lake and the upper Ohio.

The districts of which the above generally descriptive mention is made, are the Mahoning Valley, in Ohio, and the Shenango Valley and Allegheny County, and the immediately adjacent region, in Pennsylvania. These districts produced in 1889 28 per cent. (or, to be exact, 27 92 per cent) of the entire pig iron output of the United States in that year; their said product aggregated 2,378,170 net tons; an amount considerably greater than the combined product of Alabama, Illinois, New York, Tennessee, Virginia and New Jersey.

If at the expiration of the present decade Alabama and Tennessee shall have doubled their production of 1889, the joint product of those States in 1900 will be 2,172,060 net tons. Meantime the three closely-associated districts which in 1889 produced 2,378,170 net tons will have increased their joint product to something more than 4 750,000 net tons in the year 1900—provided adequate increase of facilities for supplying them with ore shall have been *in due season* effected. And the only means by which such adequate increase is possible in the waterway, construction of which is, in this report, shown to be entirely feasible.

The stock of ore to be laid in at furnaces, to provide for a production, in one year, of 4 750,000 net tons (equal to 4 241,071 gross tons) of pig iron, from Lake Superior and Menominee ores is (on the basis of actual receipts by the furnaces in said three districts in the year 1889) 8,566,963 gross tons.

No person aware of the present situation at the several iron-making points in the three districts now particularly in view, will give very much weight to ny assertion to the effect that the railways now in operation will be by any means, able to deliver at the furnaces in question (multiplied, or increased in capacity, in proportion to the increase of product in view), the great tonnage of ore just indicated as to be laid down at those furnaces in the year 1900. Substitution for the "gondola" equipment, now generally in use for transportation of ore, of cars somewhat better suited to the traffic than are the absurdly inappropriate gondolas, will largely facilitate discharge of cars at furnaces; but such belief will not satisfy the entire demand in the case.

The proposed canal affording navigation for vessels drawing as much as 14 feet of water, will not only meet the demand for enlargement of transportation facilities and diminution of cost of handling furnace stock, and at the same time largely expedite movement of such stock to its destination, and improve deliveries of ore everywhere throughout the three districts, but will complete a grand national highway from the coal fields of Eastern Ohio, Western Pennsylvania, and those regions for which the Monongahela and Kanawha rivers, respectively, are outlet to the Ohio, to all lake ports of the Great Northwest; and will be of almost inestimable benefit to the several wide domains, more immediately affected, and through them to the country at large.

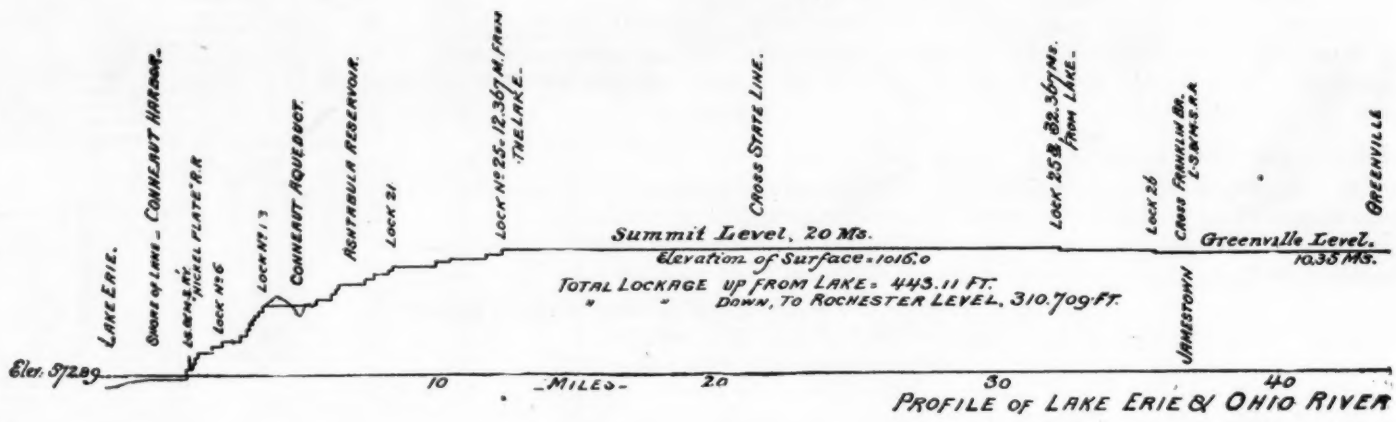
The term "expedite" is not used unadvisedly. The canal can give much better "dispatch" in delivery of ores than can any railway operating under the conditions existing, and necessarily existing, at and near the points aforesaid, at which such delivery is to be made.

The facts below stated are some of those upon which we base our assertion that the canal will facilitate and expedite, as well as reduce, the cost of the traffic under consideration.

The railways respectively delivering ores from Erie, Ashtabula, Fairport or Cleveland, to the Allegheny County district, and to the Mahoning and Shenango Valleys, have recently multiplied their main line tracks to the limit of expediency; and as far as main line tracks are in question, and, indeed, as far as inter-terminal yard-capacity has to do with the matter, will in 1891 be able to handle a tonnage considerably greater than that of 1889, or of the current year.

Practical effective capacity is, however, in a case like that in hand, to be measured by actual deliveries of the goods, transportation of which, and a practically sufficient rapidity and uniformity of delivery of the same the railway undertakes.

If conditions at any point, or combinations of circumstances of whatever kind, limit the deliveries of a road to say 8,000 tons per diem, provisions of main track, rolling stock, and motive power sufficient, under favoring circumstances, to handle 10,000 tons per diem is, to the extent of the indicated excess, not merely useless, but worse than useless, because the cost of the excess of plant is a burden upon the traffic, and, of course, upon the industries which make the traffic. With a road blockaded, cars loaded or empty must stand still; and a car is a costly warehouse, and the piece of railway which it occupies while serving as a storage bin is a costly foundation for a store-room of a capacity no greater than about 20 net tons. These being self-evident truths, our statement of them might perhaps be adjudged superfluous, except for the circumstance that among those to whom we address ourselves in support of our foregoing proposition, there are presumably many who have never given a thought to these matters. Not only is the car a costly freight receptacle, its capacity being taken into account, but it, with the railway which carries it, the engines which haul it and the various details of plant, service and administration of a railway, altogether make up a system of transportation the operation of which in a traffic affording full employment of all its capacity for service, is necessarily more costly than would be that of a canal, suited to such traffic and having like opportunity for full employment, an any route on which establishment and operation of such canal is feasible.



PROFILE OF LAKE ERIE & OHIO RIVER

[The writer here brings forward an interesting array of facts to show the expense to which railroads are necessarily exposed in carrying ore to market, and he gives figures to show that the sum of $44,000,000 is invested (exclusive of rolling stock) in the parts of railroads engaged in the lower lake ore trade. He then goes on to show that the cost of water transportation is very much lower, viz: about one-fifth of rail transportation. He gives the logs of several lake vessels in proof of this assertion, and then proceeds to consider at some length the question whether with the slow rate of speed required in a canal (say 2½ miles an hour) vessels could profitably use the canal. He makes an estimate on a 2,000-ton steamer, showing that, whereas her fuel on the lake costs $65 34 per day, on the canal it would be less than half that. He then says:]

Assuming that our canal will extend from Conneaut Harbor to Pool No. 1 of the Ohio River navigation, it will be 123¼ miles in length; and (including the proposed lock to be placed at the up-stream end of Davis Island lock), will have 53 locks, two of which have no "lift." In the canal, on the route named, there will be one level (the summit level) 20 miles in length; one next south of the summit, something more than 10 miles long; and one, from New Brighton to Davis Island lock, 23 miles long. Thus, of the 123¼ miles of canal something more than 43 per cent. will be made up of stretches in which a vessel, drawing not more than 13 feet, may move at a rate of five miles per hour, and a vessel drawing 14 feet may make three and a half and four miles per hour. Average time necessary to lockage, for largest vessels loaded, 19 2 minutes; 22 minutes at locks of 18 and 20 feet lift; 21 minutes at locks of 16 and 18 feet lift; 16 minutes at locks of 6 to 14 feet lift. We have locks as here tabulated:

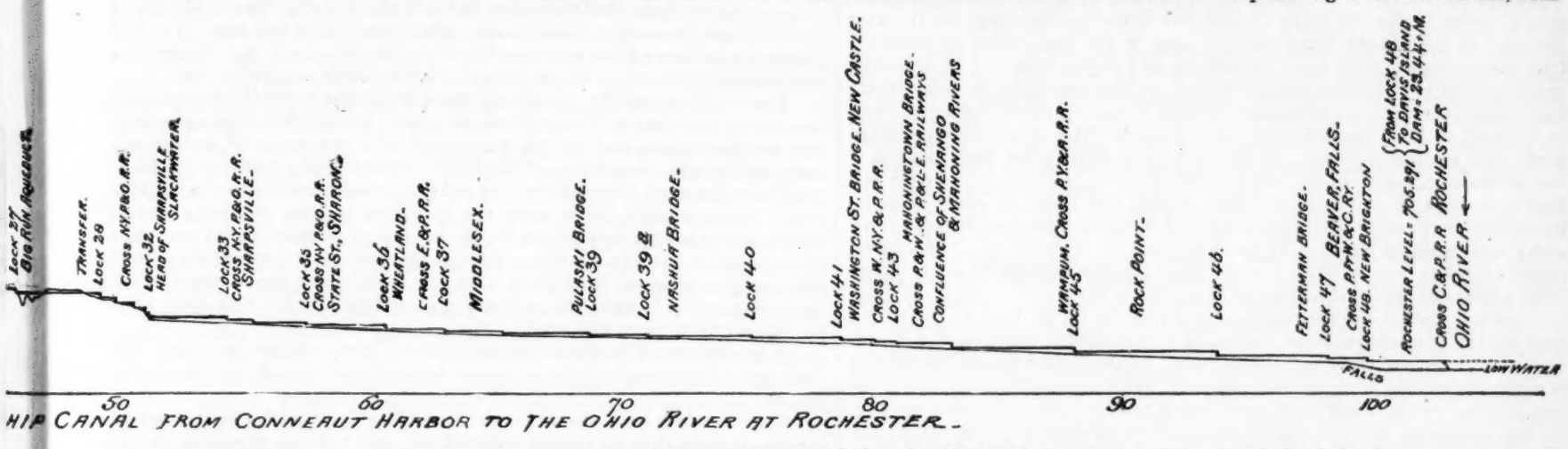
20-foot lift	18
18 to 18½-foot lift	4
16 to 17 11-foot lift	6
11 to 14-foot lift	9
6 to 11-foot lift	14
Total lifting locks	51

Aggregate time spent in locking from Lake Erie into the lock connecting

the canal with Davis Island lock: 51 lockages @ 19 2 minutes average = 979.2 minutes = 16.316 hours. Passage through Davis Island locks, 30 minutes; total, say 16 82 hours. Distance progressed in locking = 3 14 miles. Total distance Lake Erie to Pittsburgh, 128¾ miles. Distance in canal and Ohio River, exclusive of length of locks = 125 61 miles. Time expended in traveling 125.61 miles, at average rate of three miles per hour = 41.87 hours. Total time of passage, 58 69 hours = 2.445 days, say 2 45 days. And say average rate of progress for the whole 128¾ miles is 2.19 miles per hour.

Now the steamer making 44 098 miles in 36 round trips, made round trip average 1,225 miles. At her rate of 12 74 miles per hour she was under way 96.154 hours, or 4 0064 days per trip, and in the season of 210 days and 36 trips, average time expended per round trip was 5.833 days. The round trip in canal will occupy as above calculated, 4.9 days. Add one-half day, *i. e.*, 12 hours for loading with coal for return from Pittsburgh. Total in canal 5 4 days. Aggregate time for round trip = 11.233 days. At this rate she can make, in the 210 days, 18 695 round trips. She can bring, as before stated, 1,971 tons through the canal.

The 18 695 trips south represent 36,848 tons of ore; and she would take north an equal tonnage of coal. Total tonnage = 73,696 tons. Another vessel running exclusively in Escanaba trade, as our big steamer also did, got in 1889 90 cents per ton for more than 70 per cent. of her season's tonnage, and $1 and $1 25 for the remainder. Her average rate for the season was 96c. At this rate the big one earned $80,160, and to earn that amount in the canal



SHIP CANAL FROM CONNEAUT HARBOR TO THE OHIO RIVER AT ROCHESTER.

trade she would need a rate, all round, on the aforesaid 73,696 tons of freight, of $1.08 77 per ton.

The steamer which made 29,032 miles, as above noted, made 17 round trips (equal to 1,709 53 miles per round trip, 484 53 miles in excess of round trips of the last mentioned vessel) and expended 12 353 days per round trip. To this add, as before, 4 9 days for canal travel, and 12 hours for taking return load of coal from Pittsburgh, making round trip time 17.753 days. Time occupied in discharging and loading, respectively, on each trip, was counted into the 12 353 days expended as above noted, but we will still make the addition of 12 hours for loading coal. This vessel could then make but 11.829 round trips, from the Northwest to Pittsburgh and return. She can carry 1,737 tons in the canal. Her ore going south would aggregate 20 547.973 tons and her coal returning like amount: total = say 41,094 tons. She earned, in 1889, $51,480.53. To earn like amount in canal and lake traffic she would need to get rate, all round, of $1 25275 per ton. Lake rate on ore to Lake Erie ports, west of Erie, in 1889, average about $1.01. The rail rate from lake ports to Pittsburgh was $1.05. Total $2.13, including dock charges.

[Further illustrations are given, and the writer then concludes with the assertion that of the 2,350,000 tons of coal shipped to the Northwest, to, at least, 1,000,000 tons the ship canal would have afforded cheaper transportation, and this amount, he says, would be largely augmented, so that by the second season the canal would be used by at least 3,000,000 tons of Northwest-bound freight.]

Smoke Prevention in London.

Considerable success is attending the experiments now being made on the Thames embankment, London, in preventing the emission of smoke from steam-making plants. The London *Engineer* speaking of it, says:

The apparatus consists of a fan which passes the products of combustion from the fire of a portable engine into a chamber partly filled with water. The products enter a horizontal perforated tube which is partly immersed in water in this chamber, and is rotated at about 200 revolutions per minute. Upon this tube are arms carrying perforated sheet iron, so that by the rotation of the tube and these arms the water is thrown up in fine spray, through which the smoke must pass on its way to an exit from the upper part of the chamber. Perforated plates are also placed in the upper part of this vessel, through which the escaping gases must pass, and which throw down the water. The high temperature of the products of combustion which enter this chamber causes the evaporation of some of the water, which passes away as vapor at atmospheric pressure. The products of combustion, or smoke, are robbed of all carbonaceous material, and, to some extent, of other deleterious constituents, including sulphur. These collect in the water and form a scum, which is constantly drawn off. It is proved that smoke can be treated in this way, and it is claimed that the cost is small enough to commend the system and apparatus.

A MECHANIC of Pittsburgh, Pa., it is stated, is working on a process for turning out hoop iron with continuous rolls. As yet the work is entirely at an experimental stage.

IRON AND STEEL SHIPS WITHOUT FRAMES.

Patents have been granted in England for a new method of ship-building that will probably reduce the cost of punching and riveting from 80 to 90 per cent. Should the experimental plant now under construction on the Thames prove successful lake shipbuilders will be interested. If four-fifths of the cost of the punching and riveting of steamers on the lakes could be retrenched by this new process in addition to the cost of frame material, it would be worth consideration. *Industries*, London, has the following to say of the invention: "Naval architects have for many years attempted to apply hydraulic riveting to the building of our ships, but hitherto they have only succeeded in applying it to a very limited part of the structure. A new method, which will admit of the complete application of hydraulic riveting, the invention of Mr. A. C. Holzapfel, of 57 Fenchurch Street, London, about to be introduced, consists of building a ship of boxed plates, or plates flanged on all four sides. The invention was thoroughly studied by Mr. Holzapfel in conjunction with several naval architects and engineers, and he has now so far progressed as to arrange for the building of a trial ship, a vessel of small size, to be built on the River Thames. It will be seen that the adoption of this method dispenses entirely with the use of frames and keelsons, and that the flanges of the plates will form an ample substitute for these. For riveting together these flanges a movable hydraulic machine of very light structure can be used, and a similar machine will also be used for the punching of the rivet-holes, both being simultaneously punched, and the rivet holes being in consequence perfectly fair. Countersinking and surface riveting is consequently entirely dispensed with, and the labor required for the punching and riveting will be reduced from 80 to 90 per cent. on the present total for wages. A second patent for simultaneously shaping and flanging the plates, will also be acquired by the company, but the ultimate intention is, should the method under notice prove a practical success, to shape and flange the plates in heavy cast-iron or cast-steel dies by powerful hydraulic pressure, and to then build a large number of ships of the same sizes and models. We have no doubt that the experiments about to be started will be watched with great interest by the shipowning and ship-building community; and should the expectations of the inventor be realized, a very important departure in the method of building iron ships will be witnessed in 1891."—[Marine Review.

A Widened Market for Machinery.

Action of considerable importance to American manufacturers of machinery has been taken by our own and the Brazilian governments, by which, under a reciprocal agreement, and in consideration of the admission into the country free, of duty, of certain specified articles, machinery of all kinds, except sewing machines, is to be admitted to Brazil free of duty, if of American manufacture. On other manufactures of all kinds the duty to be paid is reduced 25 per cent. This results from the exemption from duty (by the recent act of Congress) of sugars, molasses, coffee, and hides. There can be no doubt of the great importance of this arrangement to manufacturers of all kinds in the United States. Brazil already imports large amounts of machinery, much of it from England, and it is altogether likely that the demand for machinery there will be a constantly increasing one as the country develops. Why sewing machines should be excepted from the full benefits of this act is more than we can understand; but for what has been accomplished our American manufacturers are to be congratulated, and we hope that they will at once prepare to push their trade in that direction to the fullest possible extent. There should be a large trade there for us at once in many kinds of machinery, such as are needed for the agricultural development of the country and for manufacturing sugar and building railroads and this of course will lead to the development of a market for many other kinds of machinery, such as machine tools.—[American Machinist.

Carriage of Iron on Natal Railways.

The cost of carriage of galvanized iron on the Natal Railways depends upon the way in which it is packed—a fact of which the manufacturers of this country should take due note. The secretary of the Durban Chamber of Commerce recently wrote to the general manager of the Natal Railways, drawing his attention to the fact that 85s. instead of 73s. 4d. per ton had been charged for conveying galvanized iron to Ladysmith. The reply was that the Chamber had evidently overlooked the note in the tariff to the effect that galvanized iron will not be accepted, unless packed in casks or tied in secure bundles, at the through up-country traffic rate. The chamber was asked to co-operate in securing the packing of iron in bundles of 2½ cwts., as much time and labor is wasted when it is sent in loose sheets.—[Glasgow Engineer.

PRODUCING STEEL AND STEEL RAILS.

The President has transmitted to Congress the report of Carroll D. Wright, the Commissioner of Labor, on the cost of production of steel and steel rails. This report is the result of several years' careful investigation in this country and Europe, with a view to ascertaining the cost of producing articles dutiable in the United States in leading countries where such articles are produced, by units of production, in order to show the differences in cost of production between this country and Europe, and the possible bearing of these differences upon tariff rates.

The report covers three features—the first relating to the cost of production of the articles selected; the second relating to the rates of wages, time, earnings and efficiency of the labor employed, and the third relating to the cost of living and total earnings and expenditures of the men employed. Colonel Wright was able to obtain the facts from 618 establishments. He divided the United States into two districts—the "Northern" and the "Southern." A comparison of the cost of materials used in the Northern and Southern districts, shows that the ore used in the Northern district cost per ton an average of $4 401; the cinder, scrap, etc., $2.631; the limestone, 79.8 cents; the coke, $3 041, and the coal, $2.695. The cost in the Southern district for the ore is $1 513; the cinder, scrap, etc, $1.031; the limestone, 70.1 cents; the coke, $3.084, and the coal, $1.566. The report shows the total cost of one ton of pig iron from the mining of the materials to the finished product in 13 establishments, seven in the Northern district, five in the Southern and one in Great Britain. In the first the direct cost of labor in the production of Bessemer iron ranges from $3 70 to $9 44; for officials and clerks, from 17 5 to 51 cents; supplies, repairs and taxes, from $1 69 to $5.32; transportation to point where used, from $1 69 to $5.32; difference between foregoing actual costs and costs as charged to blast furnace from $1 10 to $5 06. The totals therefore range from $13 97 per ton to $16 50. In the Southern district the costs per ton of run of furnace, range as follows; Direct labor, $4.32 to $7 59; officials and clerks, 19 cents to 45 cents; supplies, repairs and taxes, 66 cents to $1 29; transportation to point where used, 36 cents to $1 55; difference between foregoing and costs as charged by blast furnace, 21 cents to $2.07. The totals, therefore, range from $9 16 per ton to $10.61. In one establishment in Great Britain the total cost of these elements per ton is $10 21.

Another table shows the results of inquiries as to the cost of producing steel rails in 13 establishments, two in the United States, eight on the Continent of Europe and three in Great Britain. In the United States the net cost of materials was $21 10 at one establishment and $25 11 at the other; the total cost of labor was $1 54 and $1 38; total cost at one $24.79, and $27 68 at the other. On the Continent the net cost of materials varied from $17 69 to $19 88; the cost of labor, from $1.02 to $4 64 per ton. In the three establishments in Great Britain the net cost of materials varied from $16 39 to $18.05; the cost of labor from $1 36 to $29 54. The total, therefore, varied from $18 58 to $21 90.

Colonel Wright states that the labor cost in one ton of steel rails should be less per ton relatively in this country than in Great Britain or on the Continent, because American producers of rails dispense with at least one expensive process still adhered to by many foreign producers, and materials in the United States are purer than those used in most other countries. Hence, the quantity of ore required for the production of a ton of rails is less here than in many places abroad, and the labor required to handle the materials in a way to produce a ton is less. This is shown by the quantities of ore used in different establishments. In an establishment in the Northern district here 4,137 pounds of iron ore were necessary for the production of one ton of standard rails, while in Great Britain 5,127 pounds of iron ore were necessary for the production of one ton of practically the same kind of rails; on the Continent 5,701 pounds of ore were necessary for the production of one ton of rails. These figures, Colonel Wright says, are far more indicative of the true conditions surrounding the production of rails in the respective countries than any of the others given. The entire direct labor cost of production in these three establishments was $11 59 for the United States, $7 81 for Great Britain, and $8 10 for the Continent, showing a difference as against the United States of $3 78 in favor of Great Britain, as $3 49 in favor of the Continent.

In speaking of transportation of steel rails, Colonel Wright says that in some cases the heavy freight charge for transporting iron and steel rails benefits American manufacturers; in others it places them at a serious disadvantage at ports where there is water competition with European manufacturers.

The price of English rails per ton, without tariff, at Liverpool is $25; at New York, $25; at Chicago, $30; at San Francisco, $25. The price of English rails per ton, with tariff, at Liverpool is $25; at New York, $39; at Chicago, $44; at San Francisco, $39. The price of Chicago rails per ton at Chicago is $30; at San Francisco, $47 92, giving English rails an advantage of $6 92 over Chicago rails in the San Francisco market.

The average daily earnings of workmen in the Northern district varies from $1.47 to $2 03; in the Southern section, from $1 22 to $1 34; on the Continent, from 64 cents to 70 cents, and in Great Britain from 62 cents to 67 cents. In Great Britain and on the Continent, however, the workmen are employed only about three months in a year.

A Cheap Non-conducting Preparation for Steam Pipes.

A non-conducting coating for steam pipes, &c., used for the past ten years with perfect satisfaction by a Boulogne engineering firm, is described in a recent issue of the *Revue Industrielle* as being conveniently applied and cheap; while it can be prepared by any steam user. It consists of a mixture of wood sawdust with common starch, used in a state of thick paste. If the surfaces to be covered are well cleaned from all trace of grease, the adherence of the paste is perfect for either cast or wrought iron; and a thickness of 25 mm. will produce the same effect as that of the most costly non-conductors. For copper pipes there should be used a priming coat or two of potter's clay, mixed thin with water and laid on with a brush. The sawdust is sifted to remove too large pieces, and mixed with very thin starch. A mixture of two-thirds of wheat starch with one-third of rye starch is the best for this purpose. It is the common practice to wind string spirally round the pipes to be treated, keeping the spirals one centimetre apart to secure adhesion for the first coat, which is about 5 mm. thick. When this is set, a second and third coat are successfully applied, and so on until required thickness is attained. When it is all dry, two or three coats of coal tar, applied with a brush, protect it from the weather. It is stated that 20 frs. worth of starch will go as far in this way as 1,000 frs. spent in any known commercial non-conductors.

MELTING IRON.

In an article on the proper manner of melting iron in foundries, Charles Smith makes the following suggestions:

The mixing of iron in melting narrows down to but two sides, generally speaking. Of course, strength is always to be preserved. We either want the casting soft or medium hard. It is so easy to make them hard that we will not consider that side. Any Ohio softener that I have ever tried—and I have melted many thousand tons—will carry 50 per cent. of mill iron, scrap machinery, or stove plate. Usually it will carry more; but, taking this as a basis, we can open the grain, making softer by adding Ohio, or close the grain, making harder by adding mill iron or scrap.

I am no advocate of mixing three to six kinds of metal on one charge. I find it almost impossible to get clean, sound castings in that way. The best results are obtained when only two kinds of iron are used, and if anything comes wrong, one can locate the trouble without much expense of time.

The very best results in mixing steel with iron to obtain strength, are secured by the mixture of boiler iron with cast. Boiler trimmings and punchings was the quality used by the writer, and in a succession of tests it was never noticed that the adding of the boiler scrap to the cast iron produced blow-holes, or made the castings hard enough to cause trouble in the machine shop. Just how much boiler scrap can be added without incurring serious results I have not yet determined, but in one test 50 per cent. boiler scrap to a like amount of Ohio Scotch (No. 2) I found the mixture no harder than if good machinery scrap alone were used with the Ohio, while the strength of the castings produced from the mixture was greater by one fifth than when our gilt edged mixture was used.

It was also found in experimenting that our strongest test bar came from a mixture of 300 pounds of boiler scrap added to 700 pounds of Ohio Scotch (No. 2).

Some test bars from the above mixture developed (under test) one-third greater strength than we usually received from our ordinary mixtures, and we learned also that increasing the admission of boiler steel to the charge until one-half of the scrap was used to a like amount of the pig metal, did not tend to make the casting stronger than when the parts three and seven were used. A piece of test bar of the above mixture was heated to a dull cherry red in the blacksmith's fire, and flatted down under a steam hammer to one-half inch in thickness before breaking, and when it did break it was not off short, but in a stringy manner. Another piece was flattened in like manner, on the anvil with blows from a sledge hammer, after being heated in the manner one would heat steel before hammering.

Other steels than boiler steel, if not used carefully in mixing, will surely harden the casting, and will also have a tendency to leave fine blow holes, and although they may not impair strength in the castings, no one likes to meet them when boring, planing, or milling in the machine shop.

Old rails will mix well with cast iron, giving strength and cleanliness, but usually around a foundry there are no appliances for cutting them up into suitable lengths to admit of being placed in the cupola.

Old files must be used very sparingly, as there is something about the nature of them which makes cast iron very hard. They can be used (in a small way) by breaking the files into pieces about two inches in length, and dropping them into the bottom of a bull ladle (previously warmed) then catching the iron in the bull hot from the cupola, and after waiting a short time to give the files a chance to melt, stirring the metal vigorously with a rod, and pouring the mixture into the mold before allowing it to become dull enough to show cold shuts on the casting.

An ordinary mixture of soft cast iron will stand an admission of one part of old files to thirty of cast iron (when mixed in a ladle), and will produce a casting that will finish nicely, take a very bright polish, and at the same time have increased strength.

Charge the boiler scrap into the cupola in the following manner: After having put in the bed of fuel (coke or coal) in the bottom of the cupola, put 300 pounds of boiler scrap, and 700 pounds of Ohio iron, or some equally good softener—mixed indiscriminately—on the fuel bed, then 120 pounds of coke, and the same amount of metal, and continue so using through the heat, or as long as you wish to use boiler steel scrap on the charge.

A Large Export of Heavy Machinery.

The Gates Iron Works, of 50 South Clinton street, Chicago, builders of rock and ore breaking machinery, recently shipped to Australia eight large rock and ore breakers having a capacity equal to 9,000 tons output per day. Four of these breakers go to the Broken Hill mine, one of the most extensive mines in the world. Upward of $5 000,000 was paid by this mine in dividends last year, and it is claimed that upward of 4,000,000 tons of ore are now in sight. The other four breakers go to the government of New South Wales, where they will be used in producing rock ballast, etc., along the lines of railroad, which are there owned and operated by the government. As illustrating how easily commercial transactions are carried on with the Antipodes, it is suggestive that in less than 60 days from the time this order was placed by cable, the eight car loads of machinery were on deck in Sidney.

POINTS REGARDING THE WORLD'S FAIR.

From a recent publication of the World's Fair Commission we take the following points of general interest:

A beautiful and suitable site has been selected for the Exposition, containing fully 1,000 acres, charmingly situated on the shore of Lake Michigan. Jackson Park, in the southern section of the city, has been selected as the sight of the Main Exposition; the Lake Front, near the heart of the city, for part of it, and the Midway Plaisance and Washington Park, adjoining Jackson Park, as reserves for possible other parts. Upon these parks there had already been expended nearly $4,000,000 in improvements, prior to their being selected as the Exposition site. It is intended to use Jackson Park, in its entirety, for Exposition purposes, leaving the improved parts, as much as possible, in their present condition, while the unimproved parts will be laid out in a manner appropriate to the whole plan of buildings. The work of preparing the grounds for the Exposition is now in progress, and leading architects, selected for the purpose, are busy making plans and specifications for the buildings. Ground was broken on the 27th of January, 1891. Work will begin on the buildings in the Spring, and their construction will be pushed so as to secure, beyond peradventure, their completion in ample time for the needs of the Exposition.

In the preparation of the grounds the present Northern inlet in Jackson Park will be farther extended and become a large lagoon, enclosing the island now covered with an extensive body of native wood. This will afford a natural landscape and supply an episode of scenery in refreshing relief to the grandeur of the buildings, and, through its sylvan qualities, to the crowded and busy aspect that must be looked for almost everywhere else within the grounds. From this lagoon, a canal will continue the waterway southward along the main building, and into a large water basin which is to form the center of a Great Square about which the principal buildings of the Exposition will be grouped. Fountains will be in operation in this basin, forming a brilliant spectacle in the sunlight, or when illumed by colored incandescent lamps at night. The banks of these land-locked bodies of water are to be finished in a manner appropriate to the various localities through which they pass. The borders of the canal and the basin in the court will have embankments of stone or brick, surmounted by parapets or balustrades of stone, iron, brick or terra cotta, and opening upon steps and landings, for the use of boating parties. All walks and outdoor places for assemblages of people will be furnished with numerous seats and resting places, and will be paved with mosaics of brick, stone or concrete blocks, except where gravel or stone chips may seem more expedient. The grounds will, of course, be highly ornamented with shrubs, trees, turf and flowers.

The buildings will be impressive in appearance, and to afford protection when the weather is inclement, a grand arcade will connect the buildings so that inconvenience may be reduced to a minimum.

Opposite the Great Square, a pier, to be of such form and direction as may hereafter be determined, will project into the lake about 1,500 feet. It is to be so constructed as to form a safer harbor for the landing of lake craft. The floor of this pier will slope gently from the shore, so that visitors may get an unobstructed view of the court and its surroundings, the paved beech covered with people, and the architectural grandeur of the most imposing and important buildings of the Fair. A large restaurant and resting place will be erected at the outer end of this pier, with a band-stand and dancing floor in connection. This pier is intended to be a noted feature of the Exposition.

The government will furnish its own building and exhibits. A large open campus will be left for government use and display. Across the inlet from the government exhibit will be the building for the fisheries. A building here as beautiful as possible in appearance, will be erected of durable materials, and fitted with every arrangement and detail to carry on the propagation, subsistence, and display of water animals. A plant for heating will be supplied.

It is proposed that the exhibit of the Navy Department shall be in a building detached from the main government exhibit. The building is to be in the form, and of the dimensions of one of the new armored coast line battle ships (two of which are being constructed in Philadelphia and one in San Francisco). It is not proposed to build a fac simile of a ship in all details, excepting that part which is above the water. The berth deck of this vessel will be used in the main, as the exhibit deck of models and various other naval appliances such as have heretofore been shown on the exhibition floor of the previous exhibitions. The exterior, the main deck, the battery deck, and the military mast, will be a fac simile of the three battle ships now being constructed. The turrets will be in place, the guns in place, the boats in place, and, in fact, all the appliances as far as may be practicable. The armament of these vessels, and which will be represented in the proposed building, will consist of four 13-inch guns, eight 8-inch guns, four 6-inch guns, 20 six-pounders, and a number of smaller guns which will be mounted on the upper deck and on the military mast. The vessels of which this building will be a prototype are the largest, the heaviest, and the most formidable of any ever built in this country. They are also equipped with torpedo tubes and torpedo boats, and protected by 17-inch thickness of armor plating. It is not probable that the interior model of the ship can be exhibited in a satisfactory manner, but these different interiors will be shown in models as far as practicable.

The administration building will be the terminus of all transportation lines entering the Exposition grounds. Offices will be provided therein for bureaus of information, police, fire, public comfort, etc. It will combine architectural beauty with every facility for the dispatch of business.

The machinery hall, which will be larger than any before built, will not only cover machinery in the ordinary sense, but will furnish a great central open space, spanned with wide trusses, where there shall be the best chance possible for the display of the different transportation exhibits. Railway tracks are to be laid in all passages, and covered with the floors when not in use, so that heavy machinery may be moved about at will. These railway tracks are to lead out upon the main lines in the grounds, so that locomotives and cars may enter and depart without delay. Power houses and heating plants will be constructed in connection with this building.

The main building for manufactures is to be arranged to serve many purposes. In it, either on the ground-floor level or above, are to be special isolated rooms for judges and for special societies or committees. Here are to be restaurant and toilet rooms, toward the canal and toward the lake. The lighting of this building is to be especially cared for, and heating provided where necessary for comfort or to carry on any exhibit.

The electric and mining exhibits are to occupy each a building across the canal from the manufactories building, each adapted to its purpose and furnished with power. The one for electricity is to be adapted not only for power-house and light station, but for all displays and contests in manufacturing and by companies or persons in that business; and to be in itself, when seen from a distance, an object of beauty by day or night. This group of buildings, namely, the administration, the machinery, the manufactories, the mining and the electric, are to form a whole in design; they are intended as a mass to be impressive, as a plan most convenient, and as structures to be very substantial. The materials entering into their composition will be largely iron and masonry of brick and stone, though a free use will be made of terra-cotta, wood and other materials.

Without destroying the improved part on the north, the horticultural exhibit is to be placed there upon the open meadow. The building will be largely of iron and glass, and furnished with a plant for purposes of heating and ventilating. The large open green in front of the building will be used for the out-of door horticultural exhibits. Among the trees near this location, and placed in a way to preserve them, will be a few small, finely-designed houses, either for the States or some archæological interest. An imposing entrance arch and administration station is to be placed on the Midway Plaisance, that may be permanent, and is therefore to be of lasting materials.

The agricultural and live stock exhibits will be located in the southwestern portion of the park, where the land is comparatively high and well protected. For agriculture, which includes food products, agricultural implements and machinery, a main building is to be erected, in size and arrangement adapted to every need of this great department, and having an independent heating plant. There is also a separate department for forestry and forest products. For live stock the buildings are to be adapted to the needs as shall be expressed by those having this department in charge. In general there will be housing for stock and their attendants, and hospitals for the animals. There will be grand stands and display wings, and other buildings to meet all proper requirements. These buildings are to be temporary, but will be carefully designed with due regard to beauty and general effect. Realizing the importance of the agricultural and live stock exhibits, it is the intention of the designers to make these departments interesting in plan and appearance by all the arts at their command. A proposition to set apart $200,000 for cash premiums for the live stock exhibits is being considered, and favorable action on it is expected.

It is the intention to locate on the Lake Front Park, near the heart of the city, the buildings required for department "K," embracing fine arts, pictorial, plastic and decorative, and also a portion of department "L." Ample station facilities will be provided for the crowds who will make this ground a starting place for their visits to Jackson Park.

Among the various independent attractions which have been suggested in connection with the Exposition may be mentioned a tower 1,492 feet high, an immense mine showing the mineral wealth of the country, a floating palace hotel on Lake Michigan, a fountain of California wines, a coal palace, a corn palace, an exhibit of shoe and leather industries of the world—for which later purpose it is proposed to raise a fund of $100,000 for a special building—and other ingenious devices.

Preservatives of Iron.

Professor Lewes' investigations of the effect upon iron of the various preservative substances applied to its surface have led him to the conclusion that protectives of the class of tar and its derivatives, such as pitch, black varnish, asphalt and mineral waxes, are among the best. This, however, is conditioned upon the removal of the small quantities of acid and ammonia salts which frequently occur in tar and tar products. If, in addition to this, the class of substances mentioned is applied hot to warm iron, the bituminous and asphaltic substances form on the surface of iron an enamel which is not, like other coatings, microscopically porous, and therefore pervious to water. Spirit or naphtha varnishes are condemned by Professor Lewes; varnishes to which a body has been given by some pigment, generally a metallic oxide, are preferable to the last class, if the solvent used is not too rapid in its evaporation, and if care has been taken to select substances which do not themselves act injuriously upon iron, or upon the gums or resins that are to bind them together.

How to Paint Iron.

It is recommended by an exchange to prevent paint on iron from scaling off in large flakes, to wash the iron surfaces before any paint has been used and then brush it with hot linseed oil. If the objects are small and bear being warmed they may be heated until the linseed oil with which they are brought in contact begins to steam, then all the surfaces are carefully brushed with the oil and allowed to cool. They are then ready to take the paint. If the objects are too large and a warming not to be recommended, the linseed oil must be put on very hot. The thin liquid oil enters into all the pores, removes all the moisture and adheres so firmly to iron that frost, rain or air cannot effect a separation. To iron surfaces oiled in this manner the paint adheres well. This proceeding is also recommended for wood which is exposed to the open air.

TWO DISTINGUISHED ENGINEERS DEAD.

DR. N. AUG. OTTO.

We regret to record the death, at Cologne, on January 26, of Dr. N. Aug. Otto, the inventor of the Otto gas engine. He succumbed after a brief illness. His career exemplifies the success of perseverance and energy paired with skill and ingenuity. Luck often follows pluck, and a false start is not fatal. Mr. Otto started as a commercial traveler, for which duties his great mechanical skill was of little avail. Some circumstance turned his attention to gas engines, where his commercial capacity remained valuable. In 1867 he, in conjunction with Eugen Langen, surprised the engineers who had flocked to the Paris Exhibition, with a real, practical gas engine, an engine of the vertical type, with fly wheels on the top, not uncanny in appearance, but terribly noisy. The noise had to be borne, and was borne—for the new engine became very popular—for nine years, when the "Otto Silent" was presented. That engine has undergone such manifold improvements by the inventor and by Messrs Crossley that startling innovations and perfections are hardly to be looked for.

The gas engine in its practical career has thus quickly attained maturity. Yet the early history of the gas engine has to go back more than 200 years. It is orthodox to quote Huyghens as the first in the field, the series of originators commences, therefore, with one of the best names of physical science. Among the papers of the great physicist is one dated 1640, on a "Novel Force Derived from Gunpowder and Air." Papin took this idea up in 1688, one year after his classical experiment which initiated the steam engine; but he was not satisfied with the results. Fully a century later, Street re-opened the researches by bringing out and patenting a motor cylinder with explosion by means of a torch. Many others followed, Lebon, Samuel Brown, Bright, Barnett, Newton, Barsanti and Matteucci, Million and Lenoir and Hugon, who came very near producing a practical engine. But Langen and Otto's engine of 1867, was so decidedly superior in the economy of gas consumption that the Lenoir and Hugon engines were at once put out of the field. Otto's gas engine embraced the characteristic features of some of its predecessors—it is rarely otherwise in our days—the compression of Barnett, the cycle of Beau de Rochas, and the free piston and other advantages of Barsanti and Mattucci's engine, which was remarkable in many respects, and effected ignition by means of the electric spark. But engineers remain indebted to Dr. Otto for supplying an engine which realized and did what others, who deserve all credit, had been aiming at. We will not here contest the question of priority of invention. It has been fought out many a time; and we believe that no one will grudge Dr. Otto the benefits and comfort which his work and exertions brought him. He was an honorable man, esteemed by all who knew him, and his invention was not a lucky hit. He was not trained as an engineer, but he made himself one by hard work and study; and his achievements prove his great theoretical knowledge, mechanical dexterity and fertility of resources.

ROBERT F. MUSHET.

There died at Cheltenham, England, on January 29, in the 80th year of his age, a gentleman who was well known in the steel trade—Robert F. Mushet, the inventor of "Mushet's special steel." Mr. Mushet had the reputation of being one of the most skilled of English metallurgists. In 1875 the Iron and Steel Institute awarded to him the Bessemer gold medal, "in recognition of his great improvements in the manufacture of iron and steel." Sir Isaac Lowthian Bell, F. R S., in his "Principles of the Manufacture of Iron and Steel," acknowledges the great value of a suggestion of Mr. Mushet in regard to Bessemer steel, which was then unsuited for treatment in the converter. Mr. Mushet proposed to employ manganese, which successfully removed all impediments to the new method He patented another idea—the addition of spiegel iron to the contents of the converter. "By the aid of this valuable and important discovery," says Sir I. Lowthian Bell, "the 'red shortness' which rendered Bessemer metal unmanageable in the subsequent stages of manufacture was entirely removed." Two sons—Henry Mushet and Edward M. Mushet—are still actively engaged at Sheffield (Clyde Steel & Iron Works) in superintending the manufacture of Mr. Mushet's steels.

AMERICAN ARMOR PLATE STANDS A SUCCESSFUL TEST.

Another American-made armor plate was tested at the Annapolis naval ordnance proving ground on February 14, with results that may be very far-reaching in the development of armor. The plate tested was one which had been treated by what is known as the "Harvey process," referred to in the annual report of the Bureau of Navigation. This is the process of decarbonizing the surface of steel or iron, invented by H. A. Harvey, of Newark, N. J. The plate tested was 10½ inches thick—the same thickness as the plates tried at the competitive trial of lsst September, when such good results were obtained from the nickel-steel plate. The projectile gun and the energy of the shot at impact were made the same as in the September trial for purposes of comparison. The results obtained were quite as remarkable in their way as were those obtained from the nickel-steel plate in September, and indicate probably as great an advance in the development of armor plate.

Six-inch projectiles—three Holtzer and three Carpenter—were fired against the plate, with a striking energy of 2 988 foot tons, and two of the Carpenter shells were shattered into small fragments, effecting only about four inches penetration of the plate. One of the Holtzer projectiles, directed against the center of the plate, penetrated perhaps ten inches and was badly broken up. There are reasons for believing that the plate was probably much softer at this point than at any other, owing to certain conditions in the annealing process. The effect upon the projectiles alone considered, is believed to be the most severe trial to which armor-piercing projectiles have ever been subjected, as they were completely destroyed. It is held at the Navy Department that the plate, although cracked severely at the end of the trial, is more invulnerable for a single shot than any other plate that has ever beentested ballistically, and this after all is a greater allowance than is expected in battle. The Carpenter projectiles, manufactured in this country, behaved very nearly if not quite as well as the Holtzer. There was also made at the proving ground on Saturday a preliminary contractors' trial of the Carpenter armor-piercing projectiles for six and eight-inch guns, with the result that the Carpenter Steel Company, of Reading, Pa., has been directed to proceed at once with the completion of the contract, their shells having been extremely satisfactory.

LAKE SUPERIOR MINING NOTES.

MENOMINEE RANGE.

The Ludington mine has an order to ship 500 tons of its ore to Birmingham, Ala.—[Menominee Range.

Up to the present time the Hamilton people have been concerned principally in developing their mine, and no effort has been made to achieve a large output. The product for last year was 17,072 tons. During the current year this amount will be greatly increased. At the present time the stock-pile contains about 20,000 tons, and it is expected that by the opening of navigation it will have been increased to nearly, if not quite, twice that amount, and that 75 000 tons of ore will be produced during the year. With the connection of No. 2 shaft with the ore body some time next year, the capacity of the Hamilton will, of course, be very much enlarged, and the mine will begin to take its place among the largest ore producers in the State of Michigan —[Menominee Range.

MARQUETTE RANGE.

The Elba Co. has decided to sink the main shaft an additional 100 feet, the contract for the first 50 feet having been already let. The indications continue to be of an encouraging character, and there are none who have examined the property but predict the opening of a valuable mine.—[Negaunee Iron Herald.

The Lakeside Mining Co. has let a contract for drilling 600 feet—one hole—on its property near the south edge of the swamp at the lake. This done, others will likely be made. In the hole put down near the waterworks building something like 100 feet of good ore was passed through, but at such a depth as to render sinking a question of grave consideration. It is the hope to find the ore nearer the surface, and with this view a number of holes will be drilled to this depth.—[Negaunee Iron Herald.

At the New York mine there is enough to keep the present force of 40 men employed for the next three years, probably. The vein is dipping to the Cleveland line rapidly, and while it grows less in thickness at the same time, yet there is enough to last for the period stated.—[Iron Ore, Ishpeming.

At the property of the Iron Ore Co., just to the north of this city, Mr Robbins is rigging up a churn drill to be used to prospect the low and swampy ground. There are many who will watch explorations at this point with a great deal of interest.—[Iron Ore, Ishpeming.

The new shaft at the Mitchell end of the property has been sunk 46 feet during the past two weeks, three shifts being worked. Shaft is 16x6 feet inside of timbers.—[Iron Ore, Ishpeming.

Iron ore has been found in the homestead district of Baraga county, a limonite, possessing little or no value at present time. Enough has not yet been done, however, to prove whether a better quality would be realized by sinking a hundred feet upon the deposits. As far as we have been able to learn there has been no further tests than those of testpitting, and ledge has been reached in but few places. The drift is generally very heavy. There have been a few out-crops showing the proper formation, and something of more value may be discovered the coming Summer. We have looked at several of the deposits, finding all of them of the character above mentioned, and while present developments show little that would be considered encouraging in the older districts, yet they may lead to something better in the new.—[Iron Ore Ishpeming.

New Method of Carbon Determination in Iron.

This method depends upon the use of potassium bisulphate for rendering the iron soluble. The sample, weighing from 6 to 12 grains, either as a single piece of thin sheet or plate, or in filings or borings, but preferably the former, is heated with molten bisulphate of potassium, and completely disintegrated in 5 to 12 minutes, the iron being converted into feric sulphate, with the production of an equivalent quantity of sulphur dioxide, and the conversion of the combined carbon into carbon dioxide, while the graphite remains unchanged in the form of brilliant crystalline scales, which exactly resemble natural graphite when examined by the microscope. The gaseous products are carried by a stream of air freed from carbonic acid into a mixture of baryta water and soda-lye, forming sulphite and carbonate of barium. The former salt is oxodized to sulphate by a slight excess of permanganate of potassium, after which the carbonate is decomposed by nitric acid, the carbon dioxide is collected and measured in a special form of eudiometer, and from its volume the combined carbon is calculated.

The melted potassium ferric sulphate is a white mass containing the graphite, which is liberated by solution in weak hydrochloric acid, and may be collected on a platinum and asbestos filter, and weighed. It is then burnt by heating in a glass tube, through which the current of air and nitrous oxide vapor is passed for a few minutes. The filter, when completely cleared, is then weighed, and is ready for a fresh operation. The eudiometer in which the carbonic acid is measured is illustrated by a sketch, but not specially described. The whole apparatus is made by Mr. F. Muller, of Bonn. In decomposing the barium carbonate it is necessary to use a stream of hydrogen in order to remove the last traces of carbonic acid from the solution. This is done by placing in the flask in which the decomposition is effected, a small piece of aluminum wire wrapped round with platinum wire, and this serves the additional purpose of preventing bumping towards the end of the operation when the liquid is freed from air.—[Stahl and Eisen.

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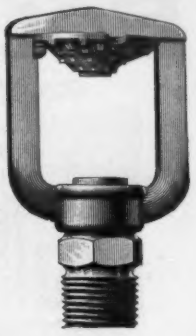

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INDUSTRIAL SUMMARY.

New Enterprises:—

A hardware factory, to cost $26,700, is to be established at Middleville, Mich.

Sioux Falls, Dak., is to have a new machine plant, which it is expected, will employ 500 men.

Ground has been broken at Jackson, Mich., for the buildings for the new Columbia Foundry Co.

W. D. Forbes & Co. are starting a new machine shop at Thirteenth and Hudson streets, Hoboken, N. J., for building special tools, guns, etc.

R. J. May has sold his foundry and machine shop at McKeesport, Pa., and has purchased another site on which he will erect a much larger plant to cost about $50,000.

A number of Chicago and Pittsburgh capitalists have located a tinplate mill in South Joliet, Ill. The firm of Lewis Bros., of Pittsburgh, are interested in the enterprise.

Contract has, it is reported, been signed by Chicago (Ill.) and other capitalists for the erection of a $200,000 structural and galvanized iron works, in Pulaski City, Va. L. J. Hyland is interested.

R. B. Hoffman & Co., of Chicago, have been incorporated to manufacture cornice and sheet metal work, to do slate and metal roofing, etc.; capital stock, $20,000; incorporators, R. B. Hoffman, John Stellen and F. Dawson.

The Western Rolling Stock Co., of Chicago, has been incorporated, with a capital stock of $100,000, by George E. Farley, Grant S. Wheeler and William E. W. Johnson. It will manufacture cars, engines and other rolling stock.

The Wells Manufacturing Co. has decided to begin the manufacture of stoves, and will immediately buy a site and erect a large factory in Indianapolis, Ind. The company has arranged to invest $50,000 in the enterprise.

The Russell Electric Manufacturing Co. have been organized at Portland, Me., for the purpose of manufacturing all kinds of machinery. The officers are: President, W. G. Chapman, Portland, Me.; Treasurer, C. W. Russell, Providence, R. I.

A charter has been issued to Klein-Logan Co., of Pittsburgh, Pa., for the manufacture of iron and steel, etc., with a capital of $100,000, and as directors; John C. Klein, of Baldwin Township; Frederick C. Klein, Pittsburgh; Wm. C. Klein, Knoxville.

The American Steam & Air Engine Co. have been organized at Portland, Me., for the purpose of manufacturing patent steam and air engines. The officers are: President, Granville Cash, of Chelsea, Mass.; Treasurer, H. M. Bullock, of Franklin, Mass.

It is announced that Rife Brothers are preparing to erect a large plant at Hazlewood, Pa., for the manufacture of wagon hardware. From 75 to 100 men are to be employed in the factory. Ground has been bought for the new works, and construction will begin soon.

An agreement has been entered into between the Ohio River Railroad Co. and the Huntington & Kenova Land & Improvement Co. for the Ohio River Road to build shops and round houses at Central City, W. Va., a new town laid out between Huntington and Kenova on the line of the extension of the Ohio River Road.

Alexander McDougall, of Duluth, Minn., and Thos. Wilson, of Cleveland, both of whom are members of the American Steel Barge Co., were at Seattle, Wash., recently, looking up a site for the shipyard, which, it is said, the company is to locate there. The company expects to be ready for business in about a year. The company expects to build ships for the coast carrying trade, and they will be in position to receive work from the new navy yard at Port Orchard.

Additions, Enlargements, Removals, etc.:—

The Smith-Hill Co., Quincy, Ill., will build an addition to their extensive machine shops.

It is stated that Berwick (Pa.) Car Works contemplate removing their plant to Bristol, Tenn.

The size and capacity of the Berlin Machine Works, at Beloit, Wis., will be doubled the coming Spring.

A large machine shop connected with the Duluth, South Shore & Atlantic Railroad, is to start up soon at Marquette, Mich.

The stockholders of the Utica Pipe Foundry, Utica, N. Y., have voted to increase the capital stock from $75,000 to $120,000, the increase to be used as working capital.

The Kingsley Foundry & Manufacturing Co., of Elyria, O., have secured a location in Hammond, Ind., and will erect on it a plant to cost $30,000.

The Brown Hoisting & Machine Co., Cleveland, has bought about five acres adjoining their present works, upon which to extend their business, as the present plant is too small.

The Hill Clutch Works, Cleveland, are rushed with orders, working night and day, and still cannot keep up. They think of building an addition to their machine shop of about 100x50 feet.

The Canonsburg Iron & Steel Co., of Canonsburg, Pa., has decided to enlarge its capacity. The firm manufactures sheet iron and steel for stamping purposes and galvanizing. The present capacity is about 4,000 tons per year.

The F. & H. Born Co., range manufacturers, of Cleveland, is about to build shops in Galion, O. The main building will be 200x65 feet, with foundry, machine shops, and other buildings necessary to carry on the business. They expect to have the new place ready by next August.

The Ball Engine Co., of Erie, Pa., has just completed a foundry, and the plans are prepared for an extensive addition to the plant. The additions will be equipped with modern tools, some of them being specially designed for the class of work. Special appliances will be put in for handling the largest engines.

President Wheat, of the recently organized Brilliant Iron & Steel Co., is said to have made a proposition to the authorities of Brilliant, O., to the effect that if the town will give the company half of a street, they will erect a bar and sheet mill in addition to the present plant, and thereby make it possible to increase the force of workmen to 500.

Glover Bros., iron founders at Frankford, Pa., have broken ground for a new plant, which will give employment to about 100 hands. They are to erect at once a brick building 52x120 feet, which will be divided into four large rooms, with a clearance of 16 feet from floor to beam. There will be a tumbling room, a finishing shop, a machine shop 30 feet square, and a two story pattern loft 20x50 feet. The latest improved machinery is to be introduced.

Fires and Accidents:—

Geo. T. McLoughlin & Co., machinists, of Boston, Mass., lost $8,000 recently by a fire in their factory.

One of the foundry buildings of Dix & Co., at Glen's Falls, N. Y., has been been burned. The loss is covered by insurance.

The machinery of the old Sheldon Axle Works, at Auburn, N. Y., which was being set up by the forge company, was destroyed by fire.

The Pullman repair shops at St. Louis, Mo., were burned on the night of the 5th inst, entailing a loss of about $300,000, partly insured.

The works of the Union Foundry & Machine Co., at Pittsburgh, Pa, were damaged to the extent of $8,000 by a fire ignited by a spark from a passing locomotive.

Fire in the foundry of the Wilkin Manufacturing Co's plant in Bay View, near Milwaukee, Wis., Feb. 12, entailed a loss of from $5,000 to $7,000, and the destruction of some valuable patterns.

The Hecla Bronze & Iron Works, at North Eleventh and Third streets, Brooklyn, N. Y., were almost completely burned out on the 4th inst. It was estimated that the amount of property destroyed was valued at $300,000.

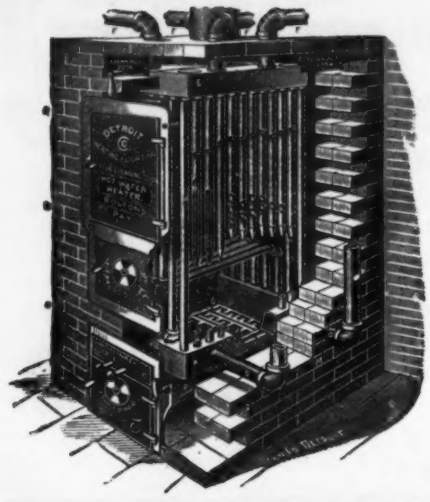
J. Henry Sternbergh & Son, bolt and nut manufacturers of Reading, Pa., were burned out Feb. 6. The plant covered several acres of ground. The fire is attributed to spontaneous combustion. The large rolling mill and several smaller structures were saved by hard work. The loss to the firm is estimated at over $275,000; insured probably two-thirds. The firm employed 600 hands.

General Industrial Notes:—

The Laidlaw & Dunn Co., of Cincinnati, O., are furnishing the Radford Pipe & Foundry Co., of Radford, Va., with 300 horse-power of Galloway boilers and six steam pumps, including a 2,000,000-gallon duplex pumping engine to supply the works and the village.

The Williams Engine Works, 447 North street, Baltimore, Md., write us they are very busy at present time. They have just sent two 18 horse-power horizontal engines to Brooklyn, N. Y., and one 35 horse power engine to

BOLTON



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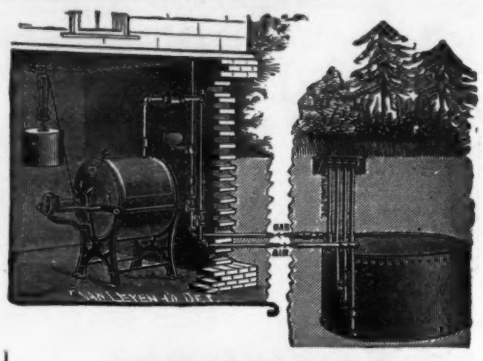

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The Detroit Heating & Lighting Co. have opened a branch at 114 Liberty street, New York, where they have secured a fine store for stock and show rooms. This branch will be managed by Mr. Geo. H. Raymond, formerly President of the Raymond Furnace Co, of Norwalk and New York. He will look after the trade in Western Massachusetts and Connecticut, Southeastern New York and New Jersey. The specialty of this company, as is well known, is the Bolton hot water heater, which they have made popular throughout the United States. Their output for 1890 was between three and four times that of 1889, and they will doubtless get their full share of Eastern trade this season.

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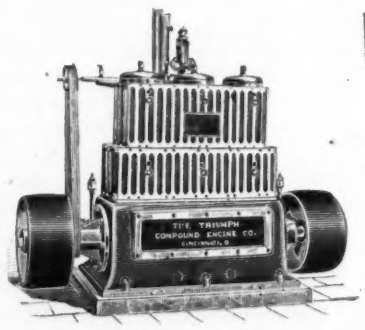

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Those seeking new fields for manufacturing establishments should not fail to investigate the wonderful development of iron, coal and coke industries that has been made within the past five years along the line of the Norfolk & Western Railroad, and the advantages offered by the State of Virginia in the supply of raw materials, by the Norfolk & Western Railroad Co. in the matter of freight facilities and rates upon raw materials, and reaching home, far distant and foreign markets, and by the cities and towns along its line in the way of advantageous sites at moderate cost. Many of the cities and towns exempt manufacturing establishments from taxation for a series of years.

For further information as to freight rates and sources of supply of raw material, maps, pamphlets, etc., apply to A. POPE, General Freight Agent, or to

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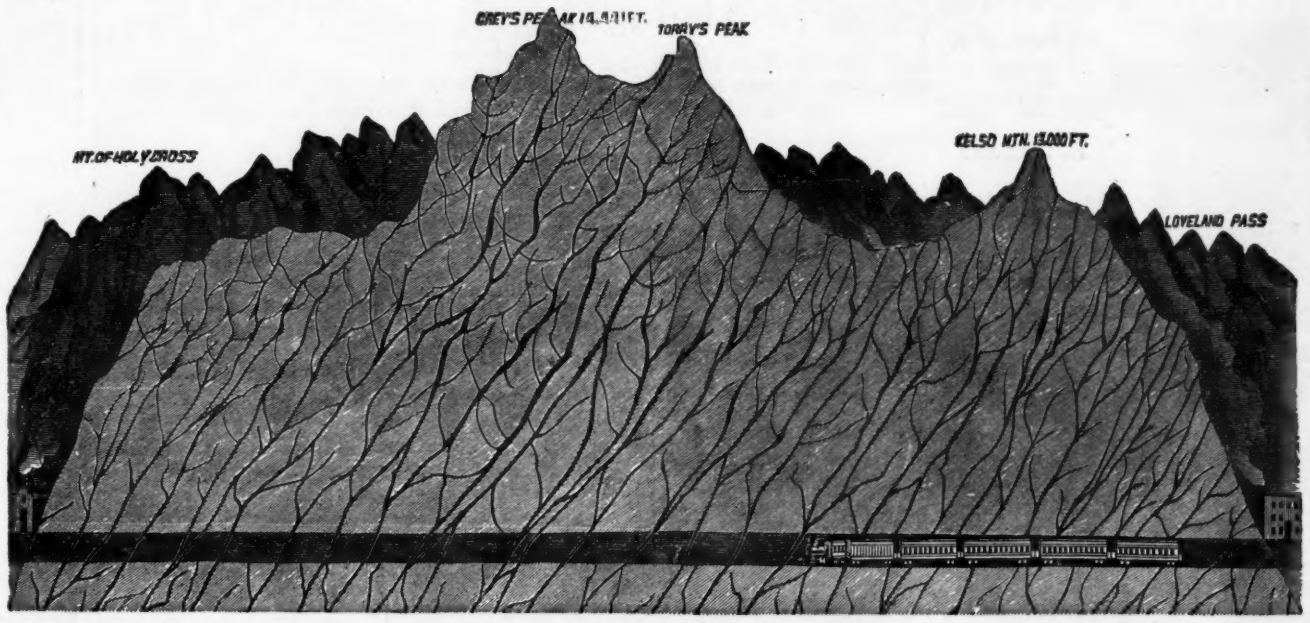

Showing what the Atlantic-Pacific Railway Tunnel Company is doing to open a tunnel or gateway through the backbone of the American Continent, so cars can run direct from Denver, Colorado, to Salt Lake City, Utah, and shorten the railway distance more than 230 miles between these two cities.

This picture shows how it is done. The object is three-fold:

1. To get access to more than 250 rich veins of gold and silver ore, that form the great mineral belt of Colorado, and that are nere found, standing as shown in the above cut. More than 250 of these fissure veins have already been discovered at the surface. They come up, following volcanic action, from the centre of the earth. From these veins thousands of tons of gold and silver ore can be brought out through the tunnel each day for market, and sold for the benefit of all who own shares issued by the Atlantic-Pacific Railway Tunnel Company.

2. To open a gateway for railway purposes through the main, snow-capped range of the Rocky Mountains, to a point 60 miles due west from Denver.

3. To open a section of conntry west from Denver, between the Rocky Mountains, comprising western Colorado and eastern Utah. This section, an area larger than the State of New York, will thus be opened to business and civilization, and made directly and easily accessible from Denver.

The cut shows the manner of getting into the hundreds of veins the tunnel is cutting through so that they can be driven into, to the right and left of the tunnel. Thus their contents of gold, silver, copper and lead, worth in cash from $100 to $3,500 per ton, can be mined out under cover the year around, dumped directly into the railway cars and run to Denver, 60 miles, direct into the smelters, without extra charge for repeated handling and wagon transportation.

These mineral bearing veins are from one to thirty feet in width. Their contents vary in thickness and quality, but the average exceeds four feet, and the average value exceeds $250 per ton.

These veins are thus opened at greater depths than any mines in the world have ever been descended into—from 1,000 to 4,000 feet below where they outcrop at the surface. Thirty per cent. of the cost of mining by the old plan of digging down into veins, pumping out water and lifting rock and ore, is thus saved by the Company.

More than 4,000 persons are now financially, jointly interested in this great enterprise. Length of tunnel from end to end, 25,200 feet. Work first begun in 1880. The Atlantic-Pacific Railway Tunnel Company became possessed by purchase in 1884. The Company owns property on which are more than 250,000 tons of low grade ore now in sight, and fully paid for. It owns several mines, claims, mill sites, and much land for town site purposes.

It has driven in at the east end into Kelso Mountain 3,000 feet, clear through the granite casing of the mountain and into the mineral grounds or veins. It has driven into the west end about 1,400 feet.

It is now taking out and shipping ore by the car load from its properties at east end of the tunnel. It has reached a two-foot wide vein of good mineral in the west end workings.

The Company is carefully organized under the laws of Colorado. All its shares are non-assessable and non-taxable. Any person can buy from the Company any number the purchaser wants and can pay for as it offers for sale. The total capitalization of the Company is $7,000,000, in 700,000 shares, par value, $10 each.

The Company is now carrying on work from the proceeds of the sale of its first mortgage bonds, par value, $250 each. These bonds pay 8 per cent. interest, and this interest is payable March 1st and September 1st each year, maturing March 1st, 1907. These bonds are a clean, clear first mortgage on all properties of the Company. They are sold as money is required for driving ahead with the tunnel. Interest from date of investment. Work goes on steadily as money is thus obtained.

The income to the Company from the sale of mineral taken from its properties will each year more than pay interest on all the bonds the Company will sell. At any time before March 1, 1893, the owner of a bond or bonds can exchange them for as many full paid, non-assessable shares as the money paid the Company for the bond would buy at $5 each, were the purchase of shares to be made now. Thus, a bond bought for $250 can be exchanged for 50 shares, and it is expected inside of three years these shares will be worth more than $20 each, and will draw from $1 to $3 or more yearly dividends each share.

In this enterprise, all stand on the same footing. Each person owning bonds will receive his interest half-yearly. The interest will be paid from the sale of ore. The Company will also have, ere long, large revenues from railway companies that will pay tollage and use the tunnel soon as completed. The Company cannot divest any person of the interests duly bought of the Company and paid for.

There is positively no chance to lose, but many to gain by purchasing bonds offered. Here is a chance to invest both money and services.

Work is going on in this enterprise constantly. None but temperance men are employed, thus ensuring more care and less liability to accidents. Positions given to investors, or, at their request, to competent persons whose services are needed as the work advances. To competent business men, financially interested, contracts will be given to open and bring ore from veins as reached by the tunnel.

The interest paid on the bonds now being sold is larger than that paid by savings banks, by their officers who, in turn, invest to larger profit. The option to exchange interest-drawing bonds for dividend-drawing shares is of itself worth as much if not more than the price paid for the bonds. For the benefit of persons disposed to economy and getting on in the world, who have not now enough on hand to buy bonds, guaranteed shares, par value, $10 each, ARE NOW OFFERED in limited number at $6 each, and each share thus sold now by the Company to bring its purchaser 50 cents a year cash, till a larger sum follows.

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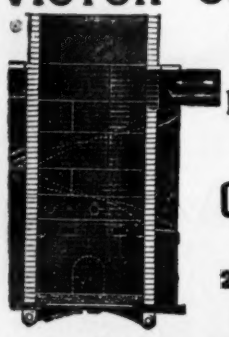

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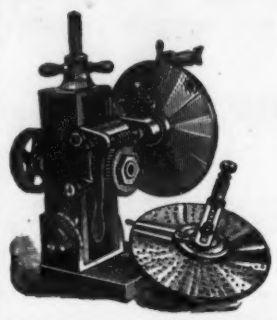

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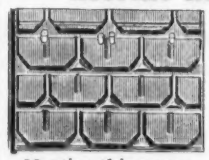

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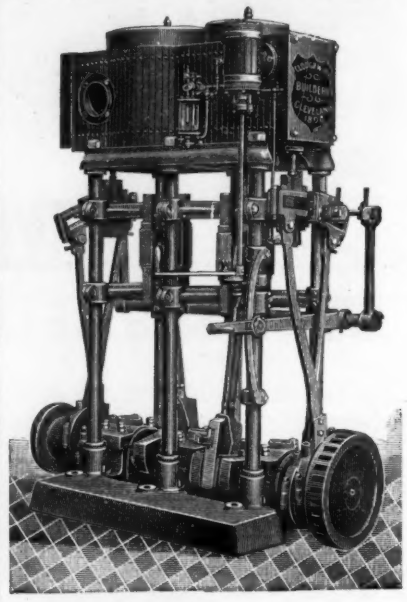

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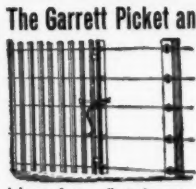

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CHICAGO (reported by Messrs. Rogers, Brown & Merwin): Southern Coke No. 1 foundry, $16 25@17 00; Southern Coke No. 2 Foundry, $15 75@16 50; Southern Coke No. 3 Foundry, $15 25@16 00; Southern Coke No 1, Softeners, $15 75@16 50; Southern Coke No. 2, Softeners, $14 75@15 50; Ohio Silveries No. 1, $18 00@18 75; Ohio Silveries No. 2, $17 00@ 17 75; Ohio Strong Softeners No. 1, $18 25@19 50; Ohio Strong Softeners No. 2, $17 50@18 75; Lake Superior Charcoal Nos. 1 to 6, $18 50@19 50; Tennessee Charcoal No. 1, $18 00@19 00; Tennessee Charcoal No. 2, $17 50@18 50; Southern Standard Car Wheel, $21 00@23 00; Tennessee Standard Car Wheel, $00 00@00 00.

CINCINNATI (reported by Rogers, Brown & Co.): FOUNDRY IRONS—Southern Coke, No. 1 foundry, $15 00@15 25; Hanging Rock Coke, No. 1 foundry, $16 50@17 50; Jackson Co. Stone Coal, No. 1 foundry, $17 00@17 50; Tennessee Charcoal, No. 1 foundry, $16 50@17 50; Hanging Rock Charcoal, No. 1 foundry, $20 00@22 00. MILL IRONS—Standard Southern Coke, grey forge, $13 00@13 25; Standard Southern Coke, mottled, $12 50@12 75; Cold Short Southern Coke, grey forge, $12 50@12 75; Strong Ohio Neutral Coke, grey forge, $14 50@15 00. CAR WHEEL AND MALLEABLE—Standard Alabama Car Wheel, $20 00@20 50; Tennessee Car Wheel, $18 50@19 50; Lake Superior Car Wheel, $19 50@20 50.

BUFFALO (reported by Rogers, Brown & Co.): Mahoning and Shenango Valley strong, No. 1 Foundry, $17 00@00 00; Mahoning and Shenango Valley strong, No. 2 Foundry, $16 00@00 00; Ohio Softener No. 1, $17 00@00 00; Ohio Softener No. 2, $16 00@ 00 00; Jackson Co. Silveries, $18 00@00 00; Lake Superior Charcoal, $20 00@00 00; Tennessee Charcoal, $19 00@00 00; Southern Softener No. 1, $16 50@00 00; Southern Softener No. 2, $15 75@00 00; Southern Strong No. 1 Foundry, $17 00@00 00; Southern Strong No. 2 Foundry, $16 25@00 00; Alabama Car Wheel, $22 25@23 00; Hanging Rock Charcoal, $23 00@24 00

LOUISVILLE (reported by Hall Bros. & Co.) HOT BLAST FOUNDRY—Southern coke No. 1, $14 25@14 50; Southern coke No. 2, $13 75@14 00; Southern coke No. 3, $13 25@13 50; Mahoning Valley (Lake ore mixtures), $00 00@00 00; Southern charcoal, No. 1, $16 50@17 00; Southern charcoal, No. 2, $16 00@16 50; Missouri charcoal, No. 1, $17 50@18 00; Missouri charcoal, No. 2, $17 00@17 50. FORGE—Neutral coke, $12 50@13 00; Cold short, $12 50@13 00; Mottled, $12 00@12 25. CAR WHEEL AND MALLEABLE—Southern (standard brands), $21 00@22 00; Southern (other brands), $17 50@18 00; Lake Superior, $21 50@22 50.

ST. LOUIS (reported by Rogers, Meacham & Shields): HOT BLAST COKE AND CHARCOAL—Southern Coke No. 1, $15 75@16 25; Southern Coke No. 2, $14 75@15 25; Southern Coke No. 3, $14 25@14 75; Southern Grey Forge, $13 75@14 25. Southern Charcoal No. 1, $17 50@18 00; Southern Charcoal No. 2, $17 00@17 50; Missouri Charcoal No. 1, $15 50@16 00; Missouri Charcoal No. 2, $15 00@15 50; Ohio Softeners, $18 00@19 50. CAR WHEEL AND MALLEABLE IRONS—Lake Superior, $20 50@21 00; Southern, $19 00@21 00. CONNELLSVILLE COKE—East St. Louis, $5 50; St. Louis, $5 65.

DETROIT (reported by William F. Jarvis & Co.): Lake Superior Charcoal, all Numbers, $19 00@19 50; Lake Superior (coke) Bessemer, $18 00@18 50; Katahdin (Maine Bessemer), $23 00@24 00; Lake Superior Coke, Foundry, all ore, $18 00@18 50; Lake Superior Coke, Foundry, all ore, $00 00@00 00; Standard Ohio Black Band, $18 00@18 50; Southern No. 1 $16 00@16 25; Southern Gray Forge, $14 25@15 00; Jackson County (Ohio) Silvery, $18 25@18 75; Old Car Wheel, $00 00@00 00. Connellsville Coke, $4.65.

LOUISVILLE (reported by Geo. H. Hull & Co.): Southern Coke No. 1 Foundry $14 00@14 50; Southern Coke No. 2 Foundry $13 50@14 00; Southern Coke No. 3 Foundry $13 00@13 50; Grey Forge, $12 50@13 00; Southern Coke Silver Grey, $00 00@00 00; Southern Charcoal No. 1 Foundry, $16 00@17 00; Car Wheel, $17 00@20 00.

PITTSBURGH (reported by A. H. Childs): No. 1 Foundry, $16 25@16 75; No. 2 Foundry, $15 25@15 75; Grey Forge, $14 25@14 75; White and Mottled, $13 50@14 00; Warm Blast Charcoal, $18 00@20 00; Cold Blast Charcoal $2 00@27 00; Bessemer, $16 00@16 50.

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1½ to 4 by ⅜ to 1 inch	1 80
4¼ to 6 by ⅜ to 1 inch	1 90
1½ to 6 by 1½ to 2 inch	2 20
1¼ & 1½ by ¾ to ¼ inch	1 90
1 & 1¼ by ¾ to ¼ inch	2 00
⅝, ¼ and ⅜ by ¾ to ⅛ inch	2 20

Round and Square.

1 to 1⅜ inch	1 80
2 to 2⅜ inch	2 00
2⅜ to 3¼ inch	2 10
3⅜ to 4 inch	2 80
4¼ to 4⅜ inch	3 30
4⅜ to 5 inch	3 50

Oval.

⅜ to 1¼ inch	2 20
⅜ to ¼ inch	2 40
⅝	2 60
¾	3 00

Half Oval and Half Round.

1⅜ to 2 inch	2 90
⅜ to 1¼ inch	2 50
⅜ to ¼ inch	3 10
⅝	3 30
¾	4 80

Heavy Band.

⅝ to 6 by ¼ and 5-16 inch	2 00
to 2½ by ¼ and 5-16 inch	2 10
⅝ to ⅞ by ⅜ and 5-16 inch	2 30
⅝ to ⅞ by ½ and 5-16 inch	2 80

Hoops.

1¼ to 4, Nos. 13 to 15	2 60
1¼ to 2, Nos. 16 to 18	2 70
1¼ to 2, No. 19	2 80
1¼ to 2, No. 20	2 90
1¼ to 2, No. 21	3 00
1¼ to 2, No. 22	3 10
15-16, 1 and 1¼, Nos. 13 to 15	2 80
15-16, 1 and 1¼, Nos. 16 to 18	2 90
15-16, 1 and 1¼, Nos. 19 and 20	3 00
15-16, 1 and 1¼, No. 21	3 10
15-16, 1 and 1¼, No. 22	3 20
⅞, Nos. 13 to 15	3 00
⅞, Nos. 16 to 18	3 10
⅞, Nos. 19 and 20	3 20
⅞, No. 21	3 30
⅞, No. 22	3 40
13-16, Nos. 13 to 15	3 20
13-16, Nos. 16 to 18	3 30
13-16, Nos. 19 and 20	3 40
13-16, No. 21	3 50
13-16, No. 22	3 60
¾, Nos. 13 to 15	3 30
¾, Nos. 16 to 18	3 50
¾, Nos. 19 and 20	3 60
¾, No. 21	3 70
¾, No. 22	3 80
11-16, Nos. 13 to 15	3 50
11-16, Nos. 16 to 18	3 70
11-16, Nos. 19 and 20	3 80
11-16, No. 21	3 90
11-16, No. 22	4 00
⅝, Nos. 13 to 15	3 80
⅝, Nos. 16 to 18	4 00
⅝, Nos. 19 and 20	4 10
⅝, No. 21	4 20
⅝, No. 22	4 30
⅝, No. 23	4 50

Light Band.

1¼ to 6 by ¼ to 3-16 in	2 20
1¼ to 6 by Nos. 11 and 12	2 30
1 to 1¾ by ⅛ to 3-16 in	2 40
1 to 1¾ by Nos. 11 and 12	2 50
⅞ and 13-16 by ⅛ to 3-16 in	2 70
⅞ and 1 3-16 by Nos. 11 and 12	2 80
¾ and 11-16 by ⅛ to 3-16 in	3 00
¾ and 11-16 by Nos. 11 and 12	3 10
⅝ and 9-16 by ⅛ to 3-16 in.	3 20
⅝ and 9-16 by Nos. 11 and 12	3 40
½ by ⅛ to 3-16 in	3 60
½ by Nos. 11 and 12	3 70

Wagon Box Iron.

⅜ inch, beveled edge, by Nos. 11 and 12	2 80
⅜ inch, " " " 13 and 14	3 00
¼ inch, " " " 11 and 12	3 10
¼ inch, " " " 13 and 14	3 30

Sheet Iron:

No. 10 to 14	2 65
No. 15 to 17	2 75
No. 18 to 21	2 99
No. 22 to 24	3 15
No. 25 to 26	3 30
No. 27	3 40
No. 28	3 50

Iron Boiler Plates.

Tank, ¼ inch and heavier	2 60
C No. 1, " "	2 85
C H No. 1 " "	3 10
C H Flange, " "	3 85
Extra Flange, "	4 35
Solid Fire Box "	5 10

Steel Boiler Plates—1-4 in. and Heavier.

Tank	2 75
Shell	3 15
Flange	3 45
Marine Flange	3 85
Fire Box	4 55

Above includes plates 90 inches wide.

90 to 96 in. wide	1/16c lb extra
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100 to 104 in. wide	1 1/16c "
104 to 116 in. wide	special

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1 to 2 in. inclusive	09
9-16 to ⅞ in "	09
7-16 to ⅝ and 2¾ to 3 in	10¼
3¼ to 4 in	11
⅞ to 11-16 and 4¼	10¼
⅞ to 6 in	11½
¼ to 9-32 and 6¼ to 7 in	12
3-6 in	14

Flats.

	cts. lbs
2 to 9-16 wide by 2 to ⅝ thick	9

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Tire	"	2 75
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Pipes and flues (Clean)	13 50
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Stove Plate	8 75
Machine Castings	11 00
Hoop and Sheet	8 00
Casting Borings	9 00
Wrought Turnings	12 00

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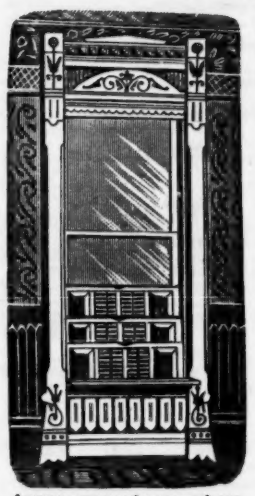

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—ONE—

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Brand new. Cheap. Address,

LUBRICATOR,

Care Iron Trade Review.

ESTABLISHED 1854.

PETER GERLACH & CO.,

MAKERS OF

Saws, Tools and Machinery.

Office and Warerooms, 28 Columbus st. Factories on Columbus, Winter and Leonard streets.

Cleveland, O., U. S. A.

COWLES

Pure Aluminum

$1.25 PER POUND.

Quality guaranteed equal to any on the market. Manufactured by

The Cowles Electric Smelting & Aluminum Co.,

LOCKPORT, N. Y.

Also manufacturers of

Cowles Aluminum Bronze,
Cowles Aluminum Brass,
Cowles Silver Bronze,
Cowles Silicon Bronze,
Cowles Aluminum Iron

INGOTS AND CASTINGS.

Correspondence elicited.

MACHINERY SUPPLY MARKET.

Anvils.

American.....₩ lb 9@10
Wrights.....₩ lb 12

Bellows.

Blacksmiths' { Hill's.....dis 40 / Bullock's....dis 50&10
Moulders'.....dis 40@40&10
Hand.....dis 40&10@50

Belting.

Boston Belting Co's standard.....dis 70
" " " extra.....dis 60&5
" " " best.....dis 55
Hoyt's Short Lap.....dis 45
Cleveland Rubber Co. extra standard..dis 60&10
Shults Raw Hide Leather Belting, single.....dis 40
Shults Raw Hide Leather Belting, double and Light Double.....dis 40
Standard, oak tanned.....dis 50@60
Alexander Brothers' pure oak tanned. ...dis 45

Blowers and Exhausters.

B. F. Sturtevant's.....dis 20
Boston Blower Co.,.....dis 35
Buffalo.....dis 35

Borax.

.....₩ lb 9¼@10¾

Chalk.

White.....₩ gross 50
White Crayon.....₩ gross 12@12½ dis 10
Red.....dis 70
Blue.....dis 85

Chucks.

Cushman's 4 Jaw Independent.....dis 45
" Combination.....dis 40
" Geared Scroll.....dis 30
" 2 Jaw Brass Workers.....dis 30
" Drill.....dis 35
Wescott's Scroll Combination.....dis 33⅓
" Independent.....dis 40
" Little Giant Drill.....dis 30
Horton's Universal.....dis 40
" Independent.....dis 45
Whiton's Independent.....dis 45
National Combination.....dis 40
Sweetland " .....dis 40
Almond Drill.....dis 20
Morse " .....dis 15
Skinner's Combination Lathe.....dis 33⅓
" Independent Lathe.....dis 40
" Universal Lathe.....dis 40
" Drill.....dis 15

Cutters and Reamers.

Cleveland.....dis 10@15
Pratt & Whitney.....dis 10@15
Standard.....dis 10@15
Brown & Sharpe, Milling Cutters.....dis 15
Gear Cutters.....dis 15

Crowbars.

Cast Steel.....₩ lb 4
Iron, steel points.....₩ lb 3½

Drill and Drill Sockets.

Twist drills.....dis 50&10
Morse Taper and Straight shank to 1¼".....dis 50&10
Morse Taper and Straight shank Larger than 1¼".....dis 25
Drill Sockets.....dis 25
Standard Twist Drills.....dis 55@55&5
Cleveland " " .....dis 55@55&5

Emery.

	No. 4 to 46 gr.	No. 54 to 150. gr.	Flour, F.	C. FF.
Kegs, ₩ lb	4 c	5 c		2½c
½ kegs ₩ lb	4½c	5½c		2¾c
¼ kegs ₩ lb	4½c	5½c		3 c
10 lb cans, 10 in case	6 c	6½c		5 c
10 lb cans, less than 10	10 c	10 c		7½c

Emery Cloth and Paper.

Barder, Adamson & Co.....dis 45@50
H. H. Barton.....dis 50@50&5

Emery Wheels.

Detroit.....dis 55@60
Norton's.....dis 55@60
Grant.....dis 55@60
Sterling.....dis 60
Celluloid.....dis 10&33⅓
Northampton.....dis 55
Crystal.....dis 65@70
Vitrified.....dis 60
Vulcanite.....dis 10&10

Files.

Nicholson.....dis 60&10@60&10&10
" X. F.....dis 25
Kearney & Foot.....dis 60&10@60&10&10
Black Diamond.....dis 60&10@60&10&10
Arcade.....dis 60&10@60&10&10
Disston's.....dis 65@70
Western.....dis 70
Stub's.....dis 25
Grobet's.....dis 30
Reynolds Bros.' Hand Cut.....dis 50
Industry File Works, hand cut.....dis 50

Hammers.

P. S. W.....dis 40
Atha new list, Jan. 15, 1887.....dis 50
Heavy hammers and sledges under 5 lbs. 18c over 5 lbs 14c, new list.

Jack Screws.

Illinois Bolt Co. list.....dis 70

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4½	4	3½	3¼
Hexagon	15⅜	11¾	8¾	6	5¼	5¾	5
Washers	9	8	7	5	4½	4⅛	4¼

In lots less than 100 lbs, ₩ lb add ¾c., 1lb boxes add 1c to list.

Nails (wire.)

List July 14, 1887.....dis 70 &10
Standard Penny Nails, ₩ keg card rate
{ Car lots.....$2.30
{ Less than car lots $2.40

Oilers.

Zinc and Tin.....dis 60
Brass and Copper.....dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz.....dis 10@10&10

Packing, Steam.

Boston Belting Co.....dis 60
American Packing Hemp.....₩ lb 10@11
Russia Packing " .....₩ lb 14
Italian Packing " .....₩ lb 12@14
Plumbago Piston.....₩ lb 40
Morrison's " .....₩ lb 50
Square Flax " .....₩ lb 50
Sheet Rubber.....₩ lb 12&24
Excelsior Rubber.....₩ lb 48

Picks.

Railroads, 5 to 6 lbs.....$12 dis 60
" 6 to 7 lbs.....$13 dis 60

Pulleys.

Iron Pulleys, Walker List.....dis 45
Medart Pulleys.....dis 55
Split Wood Pulleys.....dis 50@55

Rivets.

Iron, Thousand, list November 17, ...dis 50
Iron, Ordinary, Cooper's Block and Carriage list November 17.....dis 50
Copper.....dis 50@50&10

Rope.

Manilla, ¼ inch and over.....₩ lb 15¾
Sisal, ¼ inch and over.....₩ lb 13¾

Sand Paper.

B. A. & Co.....dis45@50
H. H. Barton's.....dis40@45
New England Flint.....dis 40@50
Barton's Garnet.....dis 20

Saws.

Disston's Circular.....dis 40@45
" Band.....dis 20
" Scroll.....Net
Hack Saw Stubs.....dis 20
" " Eureka.....dis 20
" " Star.....dis 20
Saw Swages Disston's.....dis 20
Atkins' Circular Saws.....dis 40&45
" Mill, Mulay and Drag Saws..dis 40&10
" Wood Saws.....dis 40&10
" Silver Steel Diamond Cross-cut Saws.....dis 70c per ft
" Dexter Cross-cuts.....dis 50c "
" Diamond " .....dis 30c "
" Tuttle Tooth Cross-cuts..dis 25c "
" One-man Cross-cuts.....dis 32c "
No. 1 Handles.....dis 23c per pair
No. 6 " .....dis 16c "
Excelsior Saw Tools.....$6 per doz
Perfection " .....$15 "
Detroit Saw Works, Circular.....dis 50
" " " Band.....dis 25
" " " Mulay.....dis 45

Screws.

Wood Screws—List Jan 27, 1889.

Flat head iron.....dis 50
Round head iron.....dis 40
Flat head brass.....dis 45
Round head brass.....dis 35
Square Cap.....dis 65
Hexagon Cap.....dis 60
Set C. H. C. P.....dis 70
Machine, flat head, iron.....dis 65
Machine, round head, iron.....dis 60
Bench and hand—
Lag or coach.....dis 75@75&10
Coach, patent gimlet point.....dis 75

Shovels and Spades.

Ames' list November 1, 1885.....dis 20
Dennis.....dis 5.25
Hussey & Binns, railroad.....dis 8.00

Taps.

Cards, Hand and Nut to 2 in.....dis 50
Carpenters' " " " .....dis 50
Morse " " " .....dis 50
Pratt & Whitney " " new list dis 10
Machine Screw Taps.....dis 55
Pipe Taps to 2½ in.....dis 70
Stay Bolt Taps.....dis 25
Stove Bolt Taps.....dis 50
Pulley Taps.....dis 40

Twine.	BC.	B.
No. 12, Flax Twine, ¼ and ½ lb Balls		21c@29c
No. 18 " " ¼ and ½ "		18c@28c
No. 36 " " ¼ and ½ "		16c@27c
2-Ply Hemp, ¼ & ½ lb Balls (Spring Twine)		11½c
3-Ply " 1lb Balls		12@12½c
3-Ply " 1½ lb Balls		11@11½c
Cotton Wrapping, 5 Balls to lb		15@16c

Vises.

Solid Box.....dis 60
Parker's.....dis 20@25
Prentiss.....dis 20
Stephen's.....dis 25@30
Barrett's.....dis 30
Miller's Falls.....dis 40
Merrill's.....dis 10@15
Howard.....dis 30

Wire.

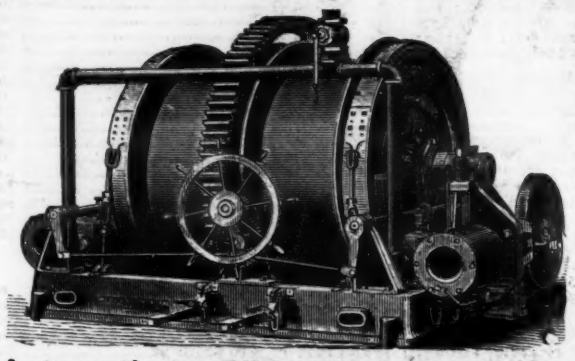
New List, Jan. 18, 1884

Brass and copper.....dis 20@25
Bright and annealed, Nos. 0@18...dis 70&10@75
" " Nos. 19@26..dis 75@75& 5
" " Nos. 27@36..dis 75&10& 5
Coppered Nos. 0 to 18, market list..dis 70@70& 5
Galvanised Nos. 0 to 18 " ".....dis 65&5
Tinned market Nos. 0 to 18.....dis 67½
Cast steel.....dis 50
Tinned Broom Wire.....dis 70&5@70&10
Annealed Fence, Nos. 8 and 9.....dis 75
Annealed Grape, Nos. 10 to 14.....dis 75
Stub's Steel Wire regular.....$6.00@lb dis 5

Wrenches.

Coe's genuine, ...dis 50
Girard Standard.....dis 70&10
Agricultural.....dis 75&10
Mechanics'.....dis 55&10,& 5
Bemis & Call's Combination .....dis 35
Donohue's Engineers.....dis 20&10
Lamson & Sessions Engineers.....dis 60
Billings & Spencer's Drop Forged.....dis 10
William's " " .....dis 10
Alligator " " .....dis 40

Webster, Camp & Lane Machine Co.



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Mining Machinery,

Improved Band Friction Hoisting Machinery, Geared or Direct Acting, for round or flat rope.

Wire Rope Haulage Machinery,

Endless or Tail Rope Systems.)

CORNISH PLUNGER AND BUCKET LIFT PUMPS.

Automatic or Slide Valve Steam Engines, Sheaves, Cages, Buckets, Etc.

Send for Catalogue D. 134 N. Main St., AKRON, OHIO.

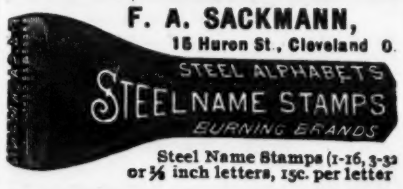
THE GUM ELASTIC ROOFING

IS ABSOLUTELY NON-COMBUSTIBLE. If painted it is Guaranteed to last 10 years. Costs only $2.00 per 100 square feet. Strongly endorsed by New York Board of Underwriters. Just the article for the South. Send stamp for circulars, samples and particulars.

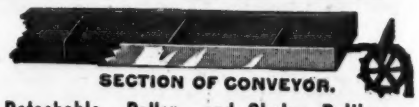
GUM ELASTIC ROOFING CO., 41 West Broadway, New York City.

THE THOS. D. WEST FOUNDRY, CO.
CLEVELAND, O.
LIGHT AND HEAVY
IRON CASTINGS.
DAILY MELTING CAPACITY 75 TONS—SPECIAL FACILITIES FOR ECONOMICALY TURNING OUT SMOOTH CLEAN CASTINGS.
DUPLICATE WORK A SPECIALTY

F. A. SACKMANN,
15 Huron St., Cleveland O.



Steel Name Stamps (1-16, 3-32 or ¼ inch letters, 15c. per letter



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Detachable Roller and Chain Belting,

MADE IN ALL SIZES OF

Malleable Iron and Steel,

DESIGNED FOR

Elevators, Conveyors, Drive Belts, etc.

For handling materials of all kinds.

CHAIN.

Send for Illustrated Catalogue. Address

The Jeffrey M'f'g Co.,
183 East 1st Ave.,
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STEEL CASTINGS

FROM 1-4 TO 15,000 LBS. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position, or for any service whatever.
60,000 CRANK SHAFTS and 50,000 GEAR WHEELS of this steel now running prove this.
Crossheads, Rockers, Piston-Heads, etc., for Locomotives. STEEL CASTINGS of every description.
Send for circulars and prices to
Chester Steel Castings Co.,
WORKS: CHESTER, PA. OFFICE 407 LIBRARY ST., PHIADELPHIA, PA.

"Treated" COTTON, Rubber Lined
Fire and Mill Hose.
Fabric Fire Hose Co.,
13 and 15 Park Row, NEW YORK, N. Y.

PATENTS
WM. M. MONROE,
SOLICITOR & COUNSELLOR, City Hall Room 48.

PATENTS THOMAS P. SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.

UNION ELECTROTYPE FOUNDRY
TELEPHONE 2139
829 SHERIFF ST. CLEVELAND O.

THE BRIGHTMAN STOKER IS THE BEST
STEAM BOILER FURNACE IN THE WORLD.
SEND FOR DESCRIPTIVE PAMPHLET. THE BRIGHTMAN STOKER Co. 201-203 RIVER ST. CLEVELAND, OHIO.

HARDWARE MARKET.

Augers and Bits.

Common augers and bits.....dis 70
Snell's.....dis 60&5
Cook's Douglass Mfg. Co.....dis 55
Russell Jennings' augers and bits.....dis 25
Expansive Bits, Clark's small, $18; large, $26.....dis 35@35&5
Hollow Augers, Ives'.....dis 25&10
Hollow Augers, Bonney's Adjust. ℔ doz., $48.....dis 40&10
Hollow Augers, Stearns' Adjust. ℔ doz., $48.....dis 20&10
Gimlet bits, common.....per gross $3 25@4 00
Standard Bit Stock Drills.....dis 50&10&5
Ship Augers.....dis 15&10@15&10&5

Axes.

Makers' and Special Brands—
First quality.....℔ doz $8 00
Others.....℔ doz $7 00
Full polished.....℔ doz $9 00

Bolts.

Cast iron barrel bolts.....dis 70
Cast iron shutter bolts, etc.....dis 70
Cast iron chain bolts.....dis 65&10
Ives' patent door bolt.....dis 60
Wrought iron barrel bolts.....dis 70
Wrought iron square bolts.....dis 70
Wrought shutter bolts.....dis 60&10
Sargent's list
Carriage, common, new list.....dis 70&10&5
Tire, common, new list.....dis 70
Carriage and tire, Philadelphia pattern.....dis 75&10
Stove bolts.....dis 60
Plow bolts.....dis 60&5
Machine.....dis 75&10@80
Ends.....dis 75&10&80

Buckets, Elevator.

.....dis 50&10

Butts.

Wrought brass.....dis 75&10
Cast brass, loose joint.....dis 33⅓
Cast Iron—
Fast joint, narrow.....dis 50&10&5@60
Fast joint, broad.....dis 50&10@60
Loose joint.....dis 70&10
Loose joint, jap.....dis 70&10
Loose joint, jap. with acorns.....dis 70&10
Loose pin, acorns.....dis 70&10
Loose pin, japanned acorns.....dis 70&10
Loose pin, acorns, jap. plated tips.....dis 70&10
Wrought steel—
Wrought, fast joint, narrow.....dis 70&10
Wrought, fast joint, broad.....dis 70&10
Wrought, loose joint, broad.....dis 70&10
Table Butts, back flaps, etc.....dis 70&10
Regular inside blind.....dis 70&10
Light inside blind.....dis 70&10
Loose pin.....dis 70&10
Light loose pin.....dis 70&10

Carbonized Felt and Building Papers.

(POWERVILLE BRAND.)

	Per roll of 500 sq. feet.
Eberts Bros., Detroit.	
No. 1—Slaters'	$1.25
"A," Stringed Roofing, Light.	1.50
"B," Stringed Roofing, Medium	1.75
"C," Stringed Roofing, Heavy	2.00
Stringed, Rosin-Sized	1.00

MILCELLANEOUS.

Asphaltum, Trinidad Refined, ℔ ton.....$30.00
Asphaltum, Fine Grade, ℔ lb.....08
Coal Tar Felt, 1 Ply, ℔ lb.....02
Coal Tar Felt, 2 Ply, ℔ roll 108 sq ft.....1.42½
Coal Tar Felt, 3 Ply, ℔ roll 108 sq ft.....1.85
Roofing Pitch, ℔ gal.....09

Chains.

Revised List.
Trace, 6¼-10-2.....℔ pair 1.03
Trace, 6¼-10-3.....℔ pair .92 } .....50&10
Trace, 7-10-2.....℔ pair 1.11
German Halter Chain, list June, 1887...dis 50&10
German Coil, list of June, 1887.....dis 50&10@60
Galvanized Pump Chain.....℔ 5¾@6
Jack Chain, Iron.....dis 75&10
Jack Chain, Brass.....dis 75

Chisels.

Socket Framing and Firmer.....dis 75
Socket Framing and Firmer, Buck Bros.dis 30
Socket Firmer and Framing, L. & I. J. White.....dis 30@30&5
Tanged Firmers.....dis 40&10

Cutlery.

Table.....net
Excelsior Pocket.....net

Fibre Ware—Standard.

	Nos. 1	3.	5X.
Pails, water, 12 qt	$4 00	$4 50	$.....
Dairy, 14 qt	4 50	5 00	.....
Fire 12 qt	5 00	....	.....
Sugar	6 00	6 50	.....
Horse	.....	5 00	.....
Buggy	4 00	.....	.....
Chamber slop Commode } 5 and 5X 14 qt.	6 50	7 50	8 50
Pans, slop, 5 and 5X 14 qt	8 00	9 00	10 00
Basins, wash—			
10¾ inch	2 00	2 25	.....
12 inch	2 25	2 75	3 25
13¾ inch	2 75	3 25	3 75
15 inch	3 25	3 75	4 25
Bowls, fruit	.....	2 50	.....
Servers, 12 in	.....	2 25	.....
Baskets, waste paper, 13 in	.....	6 00	.....
Spittons, "Daisy," pressed			
8 inch	4 00	4 50	5 00
10 and 11¾ inch	6 00	6 50	7 50

No. 1 plain; No. 5 decorated; No. 5X White decorated.

Gimlets.

Nail and Spike.....dis 50&10&5
Double cut, low list.....dis 25
"Bee".....℔ gross $12, dis 25@25&5

Hanger

Barn door, old patterns.....dis 60&10&10@70
Climax, (Anti-Friction).....dis 60
Scranton.....dis 33—
Kidder's.....dis 50&10@60
Terry's Patent.....5 in., $12; 4 in., $10, dis 50&5
Paragon.....dis 40&10
Richard's.....dis 30@30&10

Horse Nails.

No.	10	9	8	7	6	
Ausable, ℔ lb.	23	24	25	26	28	dis 40
Putnam, ℔ lb.	18	19	20	21	23	dis 15
Essex						dis 25&10

Horse Shoes.

Burden, at factory.....℔ keg $4 00
R. I. Horshoe Co., Perkins' Imp. at factory.....℔ keg $4 00
Mule Shoes, at factory.....℔ keg $5 00

Knobs.

Carriage, japanned.....℔ gross 80c dis 60&10
Base, rubber tip.....dis 70&10&5
Hematite door knobs, new list.....dis 40&10@50
Door mineral.....dis 65c@68c
Door Por. japanned.....dis 75c@78c
Door Por. nickle.....$2 00@2 25
Door Por. plated.....$2 00@2 25

Locks, Bolts, Etc.

P. & F. Corbin, Locks and Bronse Goods.
Door locks, knobs and latches.....dis 60&10
Escutcheons and keys.....dis 60&10
Padlocks and padlock keys.....dis 75
Bell pulls, mineral, porcelain and jet dis 60&10
Bell pulls, genuine bronse.....dis 60&10
Lever bell pulls, genuine bronse.....dis 60&10
Butts', genuine bronse.....dis 60&10
Butts' bronse plated.....dis 60&10
Store door locks and latches.....dis 60&10
Store door handles.....dis 60&10
Shutter hinges&flaps, genuine bronse.dis 60&10
Shutter hinges, bronse plated.....dis 70
Flush bolts, genuine bronse.....dis 70
Shutter knobs, genuine bronse.....dis 50
Shutter bars, genuine bronse.....dis 60
Sash lifts, genuine bronse.....dis 60
Sash pulls and plates, genuine bronse.....dis 60
Push plates, genuine bronse.....dis 60
Drawer pull, genuine bronse.....dis 70
Letter box plates, genuine bronse...dis 60&10
Barn door locks.....dis 33⅓
Bishop's Buckeye Sash Locks.....℔ gross $4.80

Plumbs and Leve s.

Standard list.....dis 70&10
Pocket levels.....dis 70&10
Davis' inclinometers.....dis 10&10

Pumps.

Cistern, best makers.....dis 50&10@60
Pitcher spout, best makers dis 60&10@60&10&10
Pitcher spout, cheaper goods.....dis 70@70&5

Pokes, Animal.

Bishop's I. X. L.....℔ doz $6 00
Bishop's O K.....℔ doz $5 25
Bishop's Pioneer.....℔ doz $3 75
Bishop's American.....℔ doz $2 75

Rakes.

Cast steel.....dis 70
Malleable.....dis 70@70&5

Razors.

J. R. Torrey Razor Co.....dis 20
Wostenholme & Butcher.....$10@¼...dis 10
Rifle razor.....dis ⅓ 50 net

Rat Killers.

Schuyler's.....℔ gross $15 00

Scales.

Hatch, Counter, No. 171.....℔ doz $21 00
Hatch, Tea, No. 167.....℔ doz $6 75@7 00
Chatillon's Grocers.....dis 50
Family Turnbulls.....dis 30@30&10
Scale Beams, List of January 12, 1882.....dis 50&10@50&10&4

Screw Drivers.

Stanley R. & L. Co.'s Varnished Handles.....dis 65&10
Stanley R. & L. Co.'s Black Handles..dis 60&10
Sets interchangeables.....℔ doz $18 dis 25

Squares.

Steel and iron, Nickel plated } dis 75&10@80
Disston's try square and T bevels.....dis 45&10
Winterbottom's try and miter.....dis 30&10

Tacks, Brads, Etc.

New List, Oct. 19, 1890.
American iron carpet tacks all kinds dis 77½&10
Steel carpet tacks all kinds.....dis 75&10
Swedes iron carpet tacks, all kinds dis 75&10
Swedes iron tacks.....dis 75&10
Swedes iron Upholsterers' tacks.....dis 75&10
Tinned Swedes iron tacks.....dis 77½&10
Tinned Swedes iron Upholsterers' tacks.....dis 77½&10
American iron cut tacks.....dis 77½&10
Copper tacks.....dis 4 &10
Copper finishing and trunk nails.....dis 50&10
Cigar box nails.....dis 60&10
Finishing nails.....dis 6 &10
Hungarian nails and miners' tacks...dis 60&10
Gimp and lace tacks.....dis 77½&10
" " " tinned.....dis 60&10
Trunk and clout nails.....dis 72½&10
Tinned trunk&clout nails.....dis 66&10
Basket nails.....dis 66&10
Chair nails.....dis 66&10
Common and patent brads.....dis 66&10

FREIGHT AND PASSENGER
ELEVATORS.
L. S. GRAVES & SON,
Main Office and Works, ROCHESTER, N. Y.
BRANCH OFFICES:
NEW YORK, 92 and 94 Liberty St.; BOSTON, 113 Devonshire St.; St. LOUIS, 301 Roe Building
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RUBBER GOODS
PACKING, BELTING, HOSE, GASKETS, ETC.
Fuller Bros.,
AGENTS 148 SUPERIOR STREET,
JEWELL LEATHER BELT. CLEVELAND.

ESTABLISHED 1849. INCORPORATED 188..
The Detroit Saw Works,
MANUFACTURERS OF
CIRCULAR, GANG, DRAG, MULAY & BAND
SAWS.
Moulding and Planer Knives, Emery Wheels and General Mill Supplies.
It will pay you to get our prices and guarantee.
66, 68, 70 and 72 Fort St., East,
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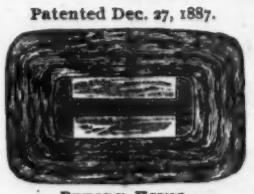
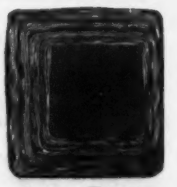
SAVE YOUR MONEY BY USING
(HERCULES.) —THE— (PEERLESS.)

Isaac B. Potts Pipe Fittings.
Consisting of Ells, Tees and Crosses, and the connecting of Iron Pipe without cutting threads and Lead Pipe without solder. For sale by the ISAAC B. POTTS PIPE FITTINGS CO., 306 North High Street, Columbus, O.

It is not a Dead, but a Live Elastic Packing.
Patented Dec. 27, 1887.

BEFORE USING.
That will pack a Steam, Water, Oil, Air or Ammonia Rod also a Smooth, Fluted, Out-of-Round or Vibrating Rod, an Engine, Pump, Ice Machine, Air Compressor, Steam Hammer, Rotary Rod, or any rod that has to be packed, and keep it tight without pressure or friction, as it works automatically.
We will prove this by yourself. If you will send for enough to pack a rod, we will send it on 30 days' trial, and prove to you that the "Sensible" Automatic Packing is the "Best" made, therefore is "Cheapest."

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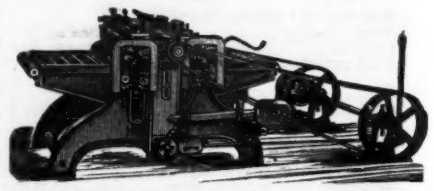

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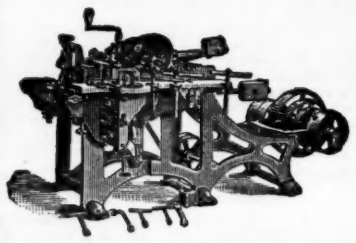

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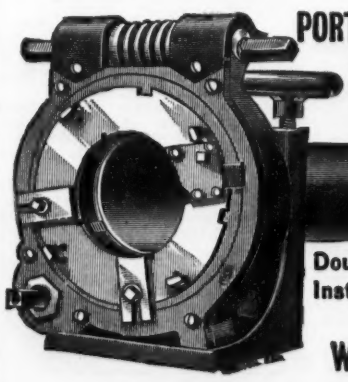

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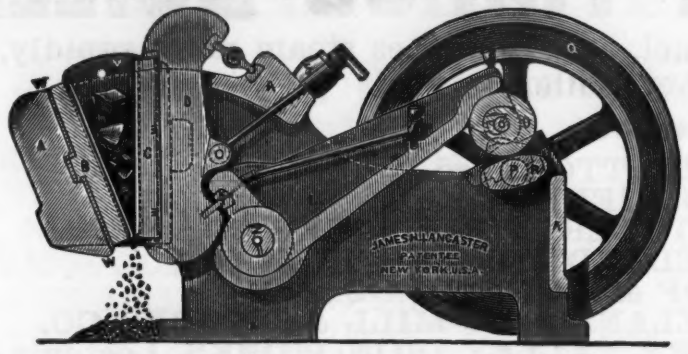

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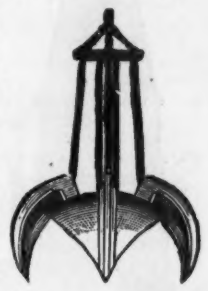

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*Daily. †Daily, except Sunday. ‡Daily except Monday.

Cleveland & Canton Railroad.

(Standard Gauge.)

Depart for—
Zanesville and Coshocton—6:50 a. m., 3:00 p. m.
Canton—6:50 a. m., 3:00 p. m., 6:20 p. m.
Kent—6:50 a. m., 3:00 p. m., *5:45 p. m. 6:20 p. m.
Bedford—6:50 a. m., 11:10 a. m., 1:30 p. m., 3:00 p. m., 4:40 p. m., *5:45 p. m., 6:20 p. m. 10:35 p. m.
Newburgh—6:15 a. m., 6:50 a. m., 11:10 a. m., 1.30 p. m., 3:00 p. m., 4:40 p. m., *5:45 p. m., 6:20 p. m., 10:35 p. m.
Arrive from—
Zanesville and Coshocton—10:30 a. m.,6:30 p. m.
Canton, 10:30 a. m., 2:35 p. m., 6:30 p. m.
Kent—*8:10 a. m., 10:30 a. m., 2:35 p. m., 6:30 p.m.
Bedford—6:00 a. m., *8:10 a.m., 10:30 a.m., 1:05 p. m., 2:35 p. m., 4:15 p. m., 6:30 p.m., 7:10 p.m.
Newburgh—6:00 a. m., 7:15 a. m., *8:10 a. m., 10:30 a. m., 1.05 p. m., 2:35 p. m., 4:15 p. m., 6:30 p. m., 7:10 p. m.
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Cleve. and Canton Express	†6 30 p m	†8 15 a m

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	Depart.	Arrive.
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	1 15 p m	12 50 p m
	d11 10 p m	6 35 p m
Wheeling and Bellaire.	7 45 a m	12 50 p m
	1 15 p m	6 35 p m
	*11 10 p m	.....
Alliance Accom.....	3 25 p m	10 10 a m
Ravenna Accom.....	5 00 p m	8 25 a m

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From Cleveland Union Station.

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	Depart.	Arrive.
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No. 70, Pittsburgh Accom.....	*11 25 a m
No. 64, New York & Pitts. Limited...	* 2 50 p m
No. 66, Mantua Accommo.....	* 4 20 p m
No. 74, Youngst'n Ex.....	† 6 00 p m
No. 68, New York & Pitts. Ex.....	*11 00 p m
	Arrive.
No. 61, N. Y. & Pittsburgh Express...	† 5 15 a m
No. 71, Youngstown Accom.....	* 7 15 a m
No. 65, New York & Pitts. Lim.....	* 9 55 a m
No. 67, Pittsburgh Accom.....	*12 45 p m
No. 73, Leavitssburgh Local.....	* 2 10 p m
No. 63, New York & Pitts. Ex.....	* 6 50 p m
No, 75, Mantua Accom.....	* 7 20 p m
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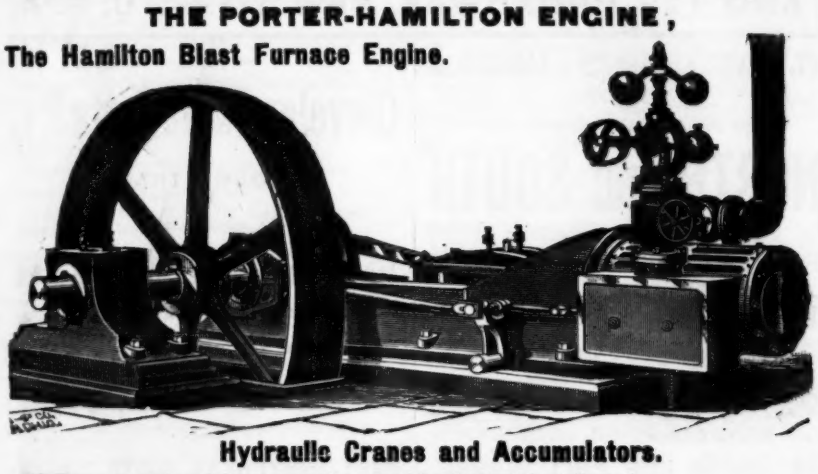

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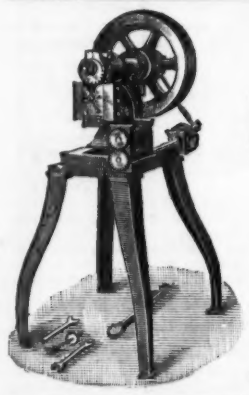

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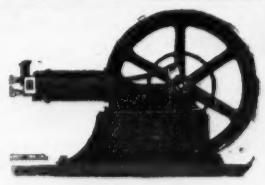

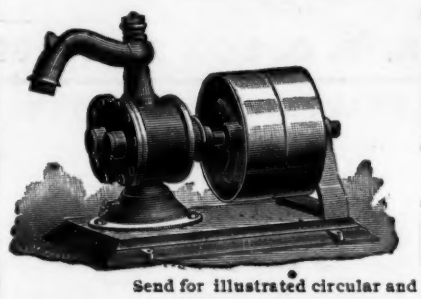

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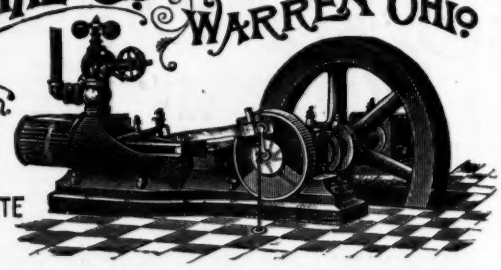

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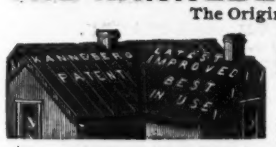

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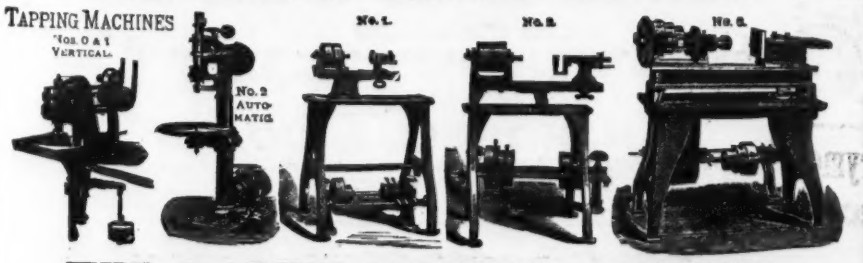

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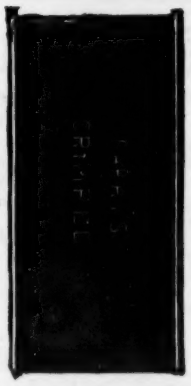

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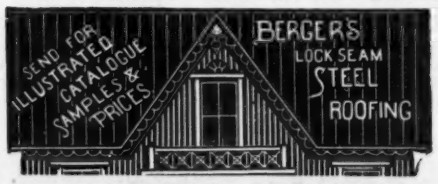

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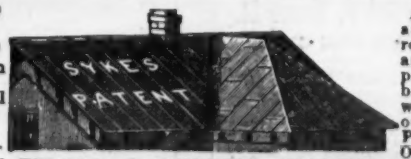

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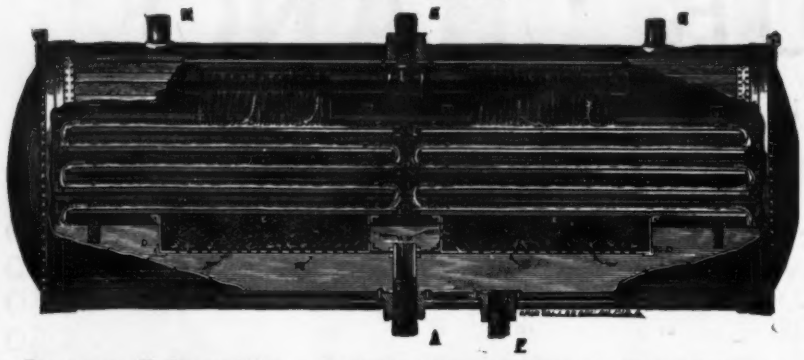

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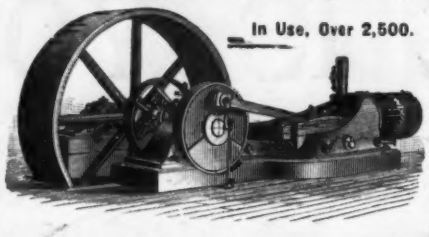

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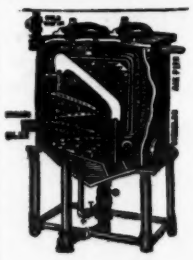

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